QUALITATIVE AND QUANTITATIVE MODIFICATIONS
OF THE MOLLUSCAN REMAINS OF A LATE ARCHAIC MIDDEN

A Thesis
Presented to
the Faculty of the Department of Biology
Appalachian State Teachers College

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts

by
Frank F. Bushnell
August 1964

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ABSTRACT

In this study the author investigated a Late Archaic aboriginal shell midden known as the Palmer Site, located on the central Gulf Coast of Florida. The purpose of this investigation was to sample and classify all biological and cultural remains or artifacts found within specific test pits. Particular emphasis was placed on the analysis of the qualitative and quantitative modifications that appeared in the valves or shells of the phylum *Mollusca*. The valves of the Virginia Oyster (*Crassostrea virginica* Gmelin) and the Bay Scallop (*Pectin irradians* Lamarck) were carefully counted and measured, the information obtained being used in the final analysis.

The final results and conclusions were that nine pelecypods and nine gastropods made up the vast bulk of the Palmer Midden. Variations in valve size of examples taken progressively from near the bottom (having a radiocarbon date of 2140 B. C.) to the top of the midden (approximately 1000 B. C.) and the disappearance of one mud-dwelling species of ark (*Arca transversum* Say) with its replacement by two other sand-bottom arks (*Arca secticostata* Reeve and *Arca pexata* Say) indicated geophysical changes characterized by a progressive rise in sea level and cyclic warm-dry, cool-wet climatic phases.

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THE PROBLEM AND DEFINITIONS OF TERMS USED

The reconstruction of the prehistoric ecology of a given area would normally be quite difficult and would require a thorough knowledge of such fields of science as palynology, geology, and paleontology as well as access to excellent reference files. There is one area of study, however, which should offer, without too much difficulty, an insight into an early ecological situation.

Along most of the waterways of the Southeastern United States ancient village sites may be located. In some areas these early sites are impressive in both acreage and in depth of deposit. This is particularly true in Florida, where evidence of man's occupancy quite often extends chronologically into the past several thousand years. A stratigraphic study of such sites, middens as they are technically called, should reveal, through an examination of food refuse, a partially reconstructable picture of the ecology of the area.

It is within this area of consideration that the author proposes the following problem.

I. THE PROBLEM

Statement of the problem. It was the purpose of this study: (1) to locate a midden site with a cultural stratigraphic history extending far enough back into time to show possible molluscan modifications; (2) to excavate by arbitrary levels a shoft or shafts down and into or through the chronologically older bottom of the midden; (3) to sample and classify all biological and cultural remains or artifacts recovered from the test pit with particular emphasis on the phylum Mollusca; (4) to use the information thus obtained to reconstruct the molluscan ecology of the immediate geographic area during the various occupation phases of the midden; (5) to note possible morphological changes that have occurred in the mollusks of the area.

Importance of the study. The study of midden stratigraphy was useful in noting trends associated with selective food gathering, the types of fauna locally available to the inhabitants of the midden, and the illustration of possible changes in the geophysical conditions of the area, such as fluctuations in sea level and changes in the salinity and the corresponding effects on the food mollusks of the local bays and estuaries during the time span covered by the midden's construction.

Specific requirements and limitations. There were specific requirements and limitations to this investigation. One of the first requirements was the location of a midden large enough in depth to cover a long time span and, if possible, one previously tested stratigraphically from the archeological standpoint so that various culture levels might be identified and accurate time periods be assigned by culture level. Ideally, the site should have carbon 14 dates already available since the cost of such dating is usually prohibitive for the individual investigator.

A description of the test area. In a discussion of the proposed problem with the Curator of Social Sciences at the Florida State Museum, the large midden located at the Palmer Estate, near Osprey, Sarasota County, Florida, was suggested.[1] This midden seemed to meet all suggested specifications, and the author was fortunate in having helped in a very small way with the initial archeological investigation.

The Palmer Site is situated in the northeast quarter of Section 4, Township 38S, Range 18E, of Sarasota County, Florida, and is approximately eight-tenths of a mile

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[1]Suggested by Ripley P. Bullen, Curator of Social Science, Florida State Museum, Gainesville, Florida, in a personal interview.

northwest of the community of Osprey on the south central Gulf Coast (Figure 1). This site consists of an artificially produced system of ridges composed of various marine mollusk shells, vertebrate bones, and occasional vegetal remains. These ridges, technically known as a midden, were formed by the accumulation of food remains and archeological materials cast aside by the Americal Indian, and represent, at this specific site, dated evidence of man's occupation, covering a time span from approximately 1000 B. C. through 2140 B. C.[2] The associated bay is listed officially on the United States Coast and Geodetic Survey maps as Little Sarasota Bay (Figure 1).

As stated in the previous paragraphs, the Palmer Site was recently tested archeologically by the Florida State Museum under the direction and supervision of Mr. Ripley P. Bullen. At this time the midden proper was investigated by extending a ten foot by ten foot shaft from the surface down eleven feet into the basal portions of the midden. The purpose of the shaft was to investigate the stratigraphic changes occurring in the archeological material with particular emphasis on possible culture changes, and to procure

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[2]Ripley P. Bullen, "Radio-carbon Dates for Southeastern Fiber-tempered Pottery," Americal Antiquity, Vol. 27, No. 1. July, 1961.

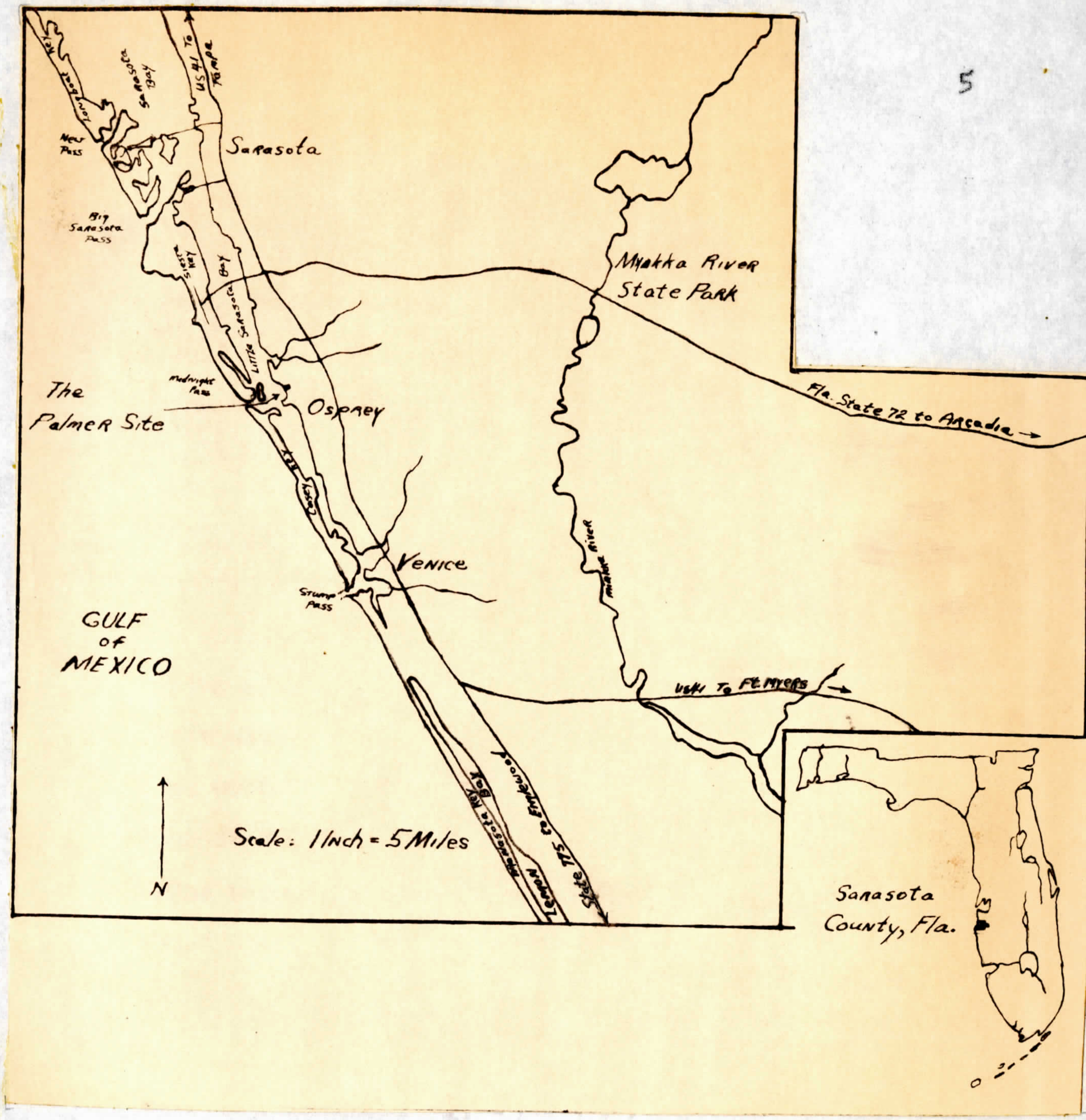

FIGURE 1

MAP OF SARASOTA COUNTY, FLORIDA
WITH LOCATION OF PALMER
SITE

carbon or shell samples at various depths for dating purposes. Figure 2 indicates the dates obtained by the carbon 14 method, the tests on the shells being run late in 1960 by H. N. Fisk, of the Humble Oil and Refining Company.[3]

It may be noted that the depths given on the chart in Figure 6 are aligned with the technical names of specific ceramic types. Archeologically, ceramic changes are used as a designator of cultural change and are of great value in determining the age of similar ceramics from other sites, each culture within certain geographic limits using somewhat similar ceramics.

It was the availability of the open test pit, permission from the owner, Mr. Gordon Palmer, to analyze the site, and the carbon 14 dates that interested the investigator in the possibility of studying this midden to gain insight into the ecology of the surrounding marine habitat during the period extending from approximately 2140 B. C. until the test portion of the midden was abandoned, some 1000 years later.

II. DEFINITIONS OF TERMS USED

<u>Prehistoric</u>. Prehistoric ecology was interpreted as meaning the relationship or association of plants and

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[3] <u>Ibid.</u>, p. 105.

animals to an environment predating the advent of written documentation in the geographic area involved. This does not imply, however, that documentation of a sort did not exist. Changes in ceramic construction were relied upon heavily for correlating culture changes with chronologic change. This in itself could be considered a valid form of documentation, especially when carbon 14 dates were available for the various culture strata involved.

Midden. The term midden refers to an artificially produced mound consisting of human food refuse and incidental cultural remains of artifacts. These middens, particularly abundant on the southeastern Atlantic Coast and along the Gulf Coast of the United States, consist primarily of mollusk shells, wind-blown sand, and ashes. The type of mollusk shells present varies with the local varieties most readily available.

Stratigraphy. In the construction of a midden, the deepest levels represent the oldest deposits in that particular site. Therefore, as the midden is excavated, the investigator proceeds down through various strata that represent regression in time. These strata, often recognizable from the transition from one pottery or ceramic type to another, quite often are rather abrupt and clear-cut.

Carbon 14 Dating. The radio-carbon method of dating is referred to as the carbon 14 method on occasion. This method was developed primarily by Dr. Willard Libby (University of Chicago) and assumes that living organisms utilize a relatively constant amount of organic carbon in its radioactive form. This radio-carbon has a half-life of 5568 $\pm$ 30 years. The presence of carbon 14 in all organic matter enables the sample to be assayed and dated with reasonable accuracy. This method is useful in dating objects containing carbon 14, provided they are no older than approximately 40,000 years.

Culture Level. The use of anthropological terminology and archeological procedure in parts of this paper were necessary in determining the age of the various strata studied. The phrase "cultural level" is used to designate a period of time in which the inhabitants of the area were associated with certain "type" artifacts, pottery being the standard "typing" device in determining culture periods. Each culture change is represented and recognized by a change in ceramic or pottery form, usually involving a change in the type of tempering material used in preparing the clay for molding. The cultural sequences or periods, as they are frequently called, are outlined in Figure 6.

Preceramic Period. The term preceramic is used to designate a period immediately preceding the invention of pottery in the geographic area concerned. The Preceramic Period itself is often classified as early part of an Archaic Period, the Archaic being preceded by a so-called Paleo Period.

Orange Period. The term Orange Period is archeologically recognized in Florida by the use of vegetal fiber as a tempering material for the plastic clay. In the rest of the United States, this type of earliest ceramics is usually designated as "Fiber-tempered Pottery."

B. C. The use of the abbreviations B. C. is intended to designate periods of time occurring "Before Christ."

B. P. The letters or abbreviations B. P. represent the words "Before the Present."

Stratimetric. This term will be used to indicate the relationship of the number of mollusk shells per stratigraphic depth unit; in essence, "Metric-stratigraphy."

III. ORGANIZATION OF REMAINDER OF THE THESIS

The remainder of this thesis is divided into the following chapters. Chapter II consists of a review of the literature, which was separated into two general headings. These headings involved first, a description of previous literature on ecological interpretations of midden remains and reports containing lists of various floral and faunal remains found within middens without ecological interpretation; second, articles referring to changes in sea level, and finally, a review of the limitations of previous studies.

Chapter III is a discussion of the methods used for analysis as well as a detailed description of each molluskan group by sample or depth unit.

Chapter IV is concerned with various aspects of the molluskan ecology of the area during the deposition periods. This chapter includes charts and graphs representing mollusk count by stratigraphic depth, mollusk species by stratigraphic depth, and size range for the common oyster (*Crassostrea virginica* Gmelin) and the bay scallop (*Pectin irradians* Lamarck) as well as the interpretations of these charts.

In Chapter V the entire problem is reviewed and summarized and the author's conclusions are presented.

CHAPTER II

REVIEW OF THE LITERATURE

Previous to this project no works of a similar nature had been done concerning the middens of the Central Gulf Coast of Florida. The primary reason for this was that until the excavation of the Palmer Midden by the Florida State Museum a site suitable for such a study, one large enough both in mass and in chronology, had not been located.

Investigations somewhat similar to the one dealt with in this paper have been done in various midden sites primarily along the Atlantic Seaboard of Florida. Even in these investigations, ecological interpretations of the areas involved were brief since the primary purpose of these papers was archeological in nature rather than biological.

A few papers have been published that propose certain problems that were considered in the investigator's study of the Palmer Site, i.e., the effect of changes in sea level and land subsidence. Work dealing with the identification of midden food in a few Florida sites, on both the Atlantic and the Gulf Coasts, has been done by other investigators, but these studies were without involved ecological interpretation.

The following paragraphs represent only a brief summary of a few of these previous investigations.

I. LITERATURE ON BIOLOGICAL REMAINS COMPOSING THE MIDDENS OF FLORIDA

Ecological investigations. One early ecological investigation of an Indian midden was done by Nelson, in his publication on chronology in Florida.[4] His investigation, made in 1918, dealt with the mode of construction of a large midden that was located near Oak Hill, Florida, on the Atlantic Coast. The investigation involved the analysis of the contents, biological and archeological, of a midden that was being destroyed for commercial purposes, in order to procure shell for roadbuilding. One of the most interesting statements that he makes deals with the observation that the deeper layers of the midden were associated with a higher concentration of Donax sp., most probably Donax variabilis Say, while the upper layers contained a higher percentage of Venus mercenaria Linne, particularly in pockets.[5] He further noted that the midden as a whole was composed of at least 85 per cent shell; 14 per cent ashes, sand, rock, and other minerals; and the final 1 per cent fish and other

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[4] N. C. Nelson, "Chronology in Florida," Anthropological Papers of the American Museum of Natural History, Vol. XXII, Part II (1918).

[5] Ibid., p. 87.

animal bones.[6] This stratigraphic layering of the Oak Hill Midden, with the greater concentration of the genus Donax being below the concentrations of the genus Venus, may or may not have any bearing on a later observation made at another site by Griffin and Smith, but it is nevertheless interesting.

In their work at the Cotten Site, Volusia County, Florida,[7] Griffin and Smith observed that the mollusk Donax variabilis Say was the primary item of diet along particular areas of the Atlantic Coast of Florida during certain early cultural periods, i.e., the Mount Taylor and the Orange Periods. Their interpretation of this observation was important in considering the reconstruction of the past ecology of the Palmer Site. As was noted in their paper, the coquina (Donax variabilis Say), which made up the greatest bulk of the Cotten Site, requires a strict marine-beach environment and will not live in brackish waters suitable for oysters. The oyster (Crassostrea virginica Gmelin), almost completely absent at the Cotten Site, requires a situation of brackish water which is completely unsuited for

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[6] Ibid., p. 86.

[7] John W. Griffin and Hale G. Smith, "The Cotten Site: An Archeological Site of Early Ceramic Times in Volusia County, Florida," Florida State University Studies, (Nov. 17, 1951), pp. 27-32.

coquina. The Cotten Site is bordered by the Halifax River, where oyster bars are found at the present. All Indian sites in the area that have a more recent date than the Cotten Site are composed primarily of oyster shells. This indicates that a change in the environment of the area had taken place during the time span between the construction-habitation period of the Cotten Site and the later, or more recent, Indian Middens.

It was considered that if the ocean level were lower at the time of occupation of the Cotten Site, the Halifax River would have been a shallow fresh-water stream and would not have supported an oyster population. Most mollusks used for food would have had to come from the ocean.

Later, as the sea level rose, a gradual flooding of the Halifax with salt water would have brought it to a brackish condition which would have been conducive to oyster growth.

The Cotten Site was occupied primarily during two periods. These periods are known to the archeologist as the mount Taylor and the Orange Periods and represent a chronological span starting at an undetermined date and ending at approximately 1000 B. C. This represents about the same chronology at the Cotten Site as is found at the Palmer Site.

It should be noted that the Mt. Taylor Period predates the use of pottery in Florida. The Orange Period, which immediately follows the Mt. Taylor, is characterized by the earliest ceramics of the area: Orange or Fiber-tempered pottery.

The Palmer Midden covers a portion of the preceramic and the Orange Period; yet it was noticed from the beginning that not only were coquina absent, but the oyster, clam, conch, and scallop--all brackish water organisms--were present in large numbers at all depths. This observation was, of course, directly related to a hypothetical question, "Was the midden shellfish, ecological situation at the Palmer Site during the preceramic and the Orange Periods comparable to the same cultural construction phases at the Cotten Site?" It would seem that the Cotten Site was in a rather unique situation and is open to further study.[8]

Neill offers evidence for subsidence of the Florida Gulf Coast owing to the great weight of sediment from the Mississippi River pushing down upon the floor of the Gulf of Mexico.[9] This subsidence of the land, together with the rise in the levels of the world's oceans,[10] should have produced

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[8]Suggested by Ripley P. Bullen in a personal interview.

[9]Wilfred T. Neill, "Historical Biography of Present-Day Florida," Bulletin of the Florida State Museum, Vol. 2, No. 7, (1957), 199-201.

[10]Ibid.

noticeable effects on the ecology of both the east coast and the west coast of Florida.

If, for example, salt water flooding the once fresh Halifax produced a situation favorable for oysters, what was the situation during approximately the same time period on the Florida Gulf Coast? To answer this question, the Palmer Site seemed ideal as a test site, for, as stated previously, the Cotten Site and the Palmer Site have somewhat similar chronological histories.

Food remains. Written material dealing strictly with the identification of food remains is occasionally found as a supplement to archeological papers. For example, an interesting reference is found in Griffin and Smith where at the Cotten Site, particularly in the Orange Period, enough dog bones were found to warrant the assumption that dogs were used as food.[11]

The knowledge of the frequency of sample occurrence was deemed essential to the understanding of just how much the inhabitants of a site depended upon certain mollusks and offered a clue into the relative abundance of various generic groups. Reference to frequency of test material, which might be termed "Metric-stratigraphy," is to be found

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[11] Griffin and Smith, *op. cit.*, p. 29.

in the article (Bushnell) dealing with an investigation of the Maximo Point Site, Pinellas County, Florida.[12] In his paper Bushnell recognizes fourteen separate mollusk generic groups in one small sample test with a total of three hundred and ninety-four specimens being taken from a 5' x 5' x 9" test pit. The most frequent genera observed were Busycon perversum Linne., Venus campechiensis Gmelin, Crassostrea virginica Gmelin, and Pectin irradians Lamarck.

The Maximo Point Site covered a fairly narrow and relatively recent time span, however, and could not be considered as being particularly helpful in this paper other than to show that essentially the same types of food mollusks have inhabited the bays of West Florida since at least the Preceramic Period. The shells recovered at the Maximo Point Site were not subjected to analysis by measurement.

A revealing article concerning the mollusks composing mounds in areas in the South East other than Florida was the article (Von der Schalie and Parmalee) dealing with mollusks found in mounds of the Etowah group in Georgia. This article mentions the extensive use of mollusks by aboriginal people and notes that "although the presence of marine species in inland sites is an indication of trade, most of the midden

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[12] Frank Bushnell, "The Maximo Point Site-1962," Florida Anthropologist, Vol. XV, No. 4, (December, 1962), 97.

shell remains are of local origin."[13]

The Summer Haven Site was investigated by Bullen and Bullen, and their publication in the *Florida Anthropologist* contains one paragraph that was of importance to this paper. It was noted, by stratigraphic profile, that there was an alternating pattern of deposition of coquina and oyster shells, which perhaps indicated local ecological changes or seasonal occupation of the midden. The authors mention that oysters are more palatable in the winter.[14] It should also have been mentioned that the coquina is more readily available in the summer. Other mollusks associated with the coquinas and oysters at the Summer Haven Site were clam (*Mercenaria*), Murex (*Murex rufus* Lamarck), the heavy Whelk (*Busycon carica elicians* Montford), and the large snail (*Polinices duplicata* Say). Shark vertebra were common, while the remainder of the food refuse consisted of the bones of turtle, fish, deer, birds, racoon, alligator, rabbit, dog, snake, crab claws, bear, oppossum, otter, wildcat, and wolf.[15] It should be stated that the Summer Haven

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[13] Henry Von der Schalie and Paul W. Parmalee, "Animal Remains from the Etowah Site, Mound C, Bartow County, Georgia," *Florida Anthropologist*, Vol. XIII, No. 2-3, (September 1960) 39.

[14] Adelaide Bullen and Ripley P. Bullen, "The Summer Haven Site, St. John's County, Florida," *Florida Anthropologist*, Vol. XIV, No. 1-2, (March-June, 1961), 12-13.

[15] *Ibid.*

Site is on the Atlantic Coast of Florida near the city of St. Augustine and is situated on essentially the same waterway as the Cotten Site. The Summer Haven Site, which covers the Orange Period in time range, is therefore important as another site coming under the geological influences that perhaps effected change in the food gathering habits of the Indians of those times.

II. LITERATURE ON CHANGES IN SEA LEVEL

A selection of articles not previously mentioned concerned with changes in sea level and land subsidence included such papers as the Shepard and Suess article on the rate of post-glacial ocean rise,[16] one dealing with the submergence of the New Jersey Coast by Stuiver and Daddario,[17] and, of most importance, the paper by Shepard dealing with post-glacial sea rise with its archeological significance.[18] In Shepard's article evidence based on a large number of recent

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[16] F. P. Shepard and H. E. Suess, "Rate of Post-glacial Rise of Sea Level," Science, Vol. 123, No. 3207, (15 June 1956), 1082.

[17] M. Stuiver and J. J. Daddario, "Submergence of the New Jersey Coast," Science, Vol. 142, No. 3594, (15 November 1963), 951.

[18] F. P. Shepard, "Sea Level Changes in the Past 6000 Years: Possible Archeological Significance," Science, Vol. 143, No. 3606, (7 February, 1964), 574-576.

carbon 14 test dates favors a slow rise of the world's oceans during the last 6000 years. Evidence is also given which tends to negate one theory which holds that the world's oceans have fluctuated during this period. This article states, for example, that extreme South Florida shows no effect of recent submergence. Still another theory, examined and rejected by Shepard, deals with the theory maintained by Fisk that the sea level has remained constant during the post-glacial period. The presence of numerous submerged, previously exposed, geologically stable areas around the world is offered as evidence against Fisk's proposals.[19]

Bullen and Bullen, in their research at the John's Island Site, note evidence of a probable rise in the sea level of over two feet since the first occupation of that specific site, probably during the late phase of the Orange Period, or at least early in the Transitional Period (a period of change from the use of fiber-tempering material to a non-fiber-tempered pottery, occurring at approximately 1000 B. C.).[20] This observation is associated with the recovery of artifacts three feet below the present water line at high tide.

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[19] Ibid., p. 574.

[20] Adelaide K. Bullen and Ripley P. Bullen, "The John's Island Site, Hernando County, Florida," American Antiquity, Vol. XVI, No. 1

Evidence showing little indication for change in the sea level of the Gulf of Mexico from 1915 A. D. through 1930 A. D. is also given in the same paper. A rise of 0.02 feet per year since 1924 was recorded at Pensacola.[21]

Neill, in communication with the investigator of this paper, outlined a consensus of several recent authorities dealing with sea level change.[22] This consensus is that around 3100 B. C. the climate was warm and the sea level was about ten feet above the present level. Between 2500 B. C. and 2300 B. C. cool climate occurred, and the sea level was about ten feet lower than the present level. At approximately 2000 B. C. a rise of the sea level to the present level occurred. A continued warming occurred from 2000 B. C. to 1800 B. C. and the sea level again rose to about ten feet above that of the present. Cooling again occurred, and the sea level fell to about six feet below the present. Finally, a warming trend occurred, beginning about 1250 B. C., the ocean's levels rising to the present day level.

One of the ecological interpretations given in this paper was based on Neill's suggestions.

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[21] Ibid.

[22] Personal communication with Wilfred T. Neill, Florida State Museum.

The second interpretation given in this paper is one based on the constant rise theory, as suggested by Dr. William J. Clinch, of the Museum of Comparative Zoology, Harvard University, through personal communication.

III. LIMITATIONS OF PREVIOUS STUDIES

The primary limiting factor in previous studies is that all work in this general geographic area has dealt with archeology rather than biology or ecology.

Very few publications dealing with the rise in elevation of the world's oceans, or, more specifically, the Gulf of Mexico, agree on what has actually occurred. The same was true concerning articles on the subsidence of land masses. No works could be located associating the east coast to the west coast of Florida with respect to rises in the sea level or land subsidence.

The one paper dealing with the Cotten Site[23] was written in 1947. Concepts dealing with ecological changes as reflected by the middens of the Florida East Coast have changed. Bullen and Bullen, in their paper on the Summer Haven Site, note stratigraphic changes that are seasonal

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[23] Griffin and Smith, "The Cotten Site: An Archeological Site of Early Ceramic Times in Volusia County, Florida," loc. cit.

rather than reflective of geophysical change.[24] These two sites--the Cotten Site and the Summer Haven Site--occupy nearly the same time range but show different stratigraphic construction. Correlative work between the two sites would be extremely helpful in getting a more valid picture of midden construction during the chronologic periods encompassing the late Preceramic, Orange, and Transitional culture periods, in essence, the periods in which the Palmer Site was constructed.

No publications were available concerning the selective gathering habits on the part of the Indians. Perhaps changes in mollusk shell size, such as a trend towards reduced shell size towards the top of the midden, merely indicate a tendency to over-gather, thereby preventing the organism from attaining what might be termed maximum size. This reduction in the overall size of any given generic group may not have anything to do with geophysical change, although this would be extremely unlikely.

It has been suggested that the Cotten Site is merely a unique situation and should be used only as a tool for comparison with the Palmer Site, and then with great caution.[25]

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[24] Bullen and Bullen, "The Summer Haven Site, St. John's County, Florida," <u>loc. cit.</u>

[25] Ripley P. Bullen--Personal interview.

Basically, however, no work of a nature such as is presented in this paper had been attempted on the middens of the Central Gulf Coast of Florida; therefore, published references were infrequent and usually applied to other regions of the State or Nation.

Finally, although any given sample column in a midden is a valid history of that portion of the site, it is felt by the investigator that other middens of the same age or chronologic span, and in the same geographic location, should be tested and the results compared. This suggestion in itself limits the study, as there are no other recorded sites on Little Sarasota Bay with a chronologic history similar to that of the Palmer Site.

CHAPTER III

EXPERIMENTAL TECHNIQUE AND ANALYSIS

As stated in Chapters I and II, the Florida State Museum excavated a portion of the Palmer Site during the spring of 1960. This excavation, completed for archeological purposes, resulted in a test pit ten feet by ten feet in area and extending down into the midden to a depth of eleven feet. Carbon and shell samples were obtained, and, after testing, dates were assigned to appropriate levels of the excavation.

For the purpose of a biological assay of the food remains in the midden, this abandoned test pit was ideally suited.

I. METHOD OF EXCAVATION

Sampling. The procedure used in testing consisted of progressive bagging and labeling of one-cubic-foot units of midden material from the surface down the wall of the test pit into and including the deepest portion dated.

In order that control be maintained, a similar shaft was extended to the bottom of the midden test pit, one foot away from the initial sample column. These two sample columns were referred to as Test I, the primary experimental test, and Test II, the control. It should be pointed out that different tests in a given midden may produce a difference in the number of the strata uncovered. It is explained by Griffin and Smith that while one portion of the midden was under occupation another might be accumulating humus, or even wind-blown sand. They go on to say that even though variables exist which prevent identification of uniform horizons equivalent in time over the site as a whole, an individual column yields a valid picture for the time spread of that one spot.[26]

After both Tests I and II were completed, the sample bags, each containing one cubic foot of midden material, were taken to the laboratory and analyzed by classifying all mollusk remains per sample bag and by measuring all whole shells of certain genera.

The information derived from these test sample bags (gave indication of) of the food collecting habits over a long time span. It was useful in understanding the selective nature of food gathering, for, without a doubt, only the mollusks of better flavor as well as availability were collected by the Indians of the area. The measurements of the given generic groups offered an insight into possible changes in the internal environment of Little Sarasota Bay that might have affected the molluscan ecology as a whole.

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[26]Griffin and Smith, _op_. _cit_., p. 30.

II. METHODS OF ANALYSIS OF THE MIDDEN REFUSE WITH A DESCRIPTION OF THE GROUND SURFACE

The analysis of the contents of the cubic-foot samples from Test I and II involved careful screening away the loose sand and then identifying all remains and artifacts large enough to be recognized with the unaided eye. It was considered superfluous to attempt identification and classification of fragments smaller than this because of the tremendous amount of material in each sample.

As each item was identified, a careful count was kept and certain mollusk genera were measured with a Vernier caliper. The generic groups measured represented the mollusks of highest numerical occurrence. Only whole specimens were used for measurements.

Although the general appearance of the surface of the midden is of no great importance to this study, it was decided that a brief description was in order to familiarize the reader with the physical appearance today.

The flora of the surface of the area confined within the limits of Test I and II consisted of Poison Oak (<u>Rhus toxicodendron</u> L.) and Spanish Needle (<u>Bidens pilosa</u> L.). The roots of these plants penetrated loosely into a rich black humus composed of decayed and decaying Live Oak leaves and acorns (<u>Quercus virginiana</u> Mill.). This humic layer extended no deeper than two inches, at which level a finely crushed layer of shell was encountered. As the test was extended downward, the tendency towards complete shells increased; but nowhere within the surface sample was the shell compact. Loose black soil accounted for approximately one-third of the total volume of the 0"-12" samples.

Three artifacts of aboriginal province were encountered in the upper six inches of Test I. These consisted of two pottery sherds of a heavy, sand-tempered, undecorated nature that might be designated archeologically as Residual Plain. One fragment of a sandstone hone completed the list.

As stated previously, very few whole mollusk shells were encountered in this specific surface sample. In order to obtain a count, an accumulation of shell fragments approximately equivalent to one whole shell was counted as one complete example. This procedure was used only in the upper six inches.

Those shells found in the most complete state at all depths were primarily the Florida Conch (<u>Strombus alatus</u> Linne), the Bay Scallop (<u>Pectin irradians</u> Lamarck), and the Virginia Oyster (<u>Crassostrea virginica</u> Gmelin). The smaller varieties were usually in a complete state provided they were protected in some manner, such as being stacked or under a larger specimen.

Representatives of the phylum Mollusca were classified by Class, Family, Order, Genus and species. Depth of occurrence and the total count by depth were also recorded. A written description of each type represented within the samples was included below the individual binomial nomenclature.

III. STRATIMETRIC ANALYSIS AND DESCRIPTION OF THE PHYLUM MOLLUSCA - TEST I AND TEST II

CLASS - PELECYPODA

FAMILY - ARCIDAE

Genus Arca Linne 1758

Arca pexata Say

Bloody Clam
P. 95

DEPTH IN INCHES	SHELLS PER SAMPLE TEST I	TEST II
0-12	2	1
12-24	1	0
24-36	3	1
36-48	12	7
48-60	0	2
60-72	6	0
72-84	0	1
84-96	0	0
96-108	0	0
108-120	0	0
120-132	0	0

The Arc, or Bloody Clam, is a very common member of its family, and is interesting biologically in that it possesses red blood. It averages about two inches in length and has a very rugged shell. Its habitat is shallow water with a sandy bottom. As a food it would certainly have been desirable. Moreover, the valves were used as ornaments and tools.

Arca secticostata Reeve   Cut Ribbed Ark
P. 96

Only one example of this Ark was located in Test I. This example was found at the 60"-72" depth. Three examples were recovered in Test II. Two of these were at the 24"-36" level and one was at depth 72"-84".

This species of Ark averages two to three inches in length, is white, and is characterized by a straight hinge line, thirty-five ribs, and a deep central line extending most of the length of each rib. It is common from South Carolina to Texas and lives in moderately shallow water. As with the other Arks, it was occasionally collected for food and for the valves, which, as stated previously, were used as tools and ornaments.

Arca transversum Say — Transverse Ark
p. 96

DEPTH IN INCHES	SHELLS PER SAMPLE TEST I	TEST II
0-6	0	0
6-12	0	0
12-24	0	0
24-36	0	0
36-48	0	0
48-60	0	0
60-72	0	0
72-84	0	0
84-96	0	0
96-108	26	6
108-120	32	18
120-132	16	22

The Transverse Ark is a small member of its family, averaging about one inch in length. This species is primarily an off-shore mollusk, preferring muddy to sandy bottoms. It is interesting to contemplate whether there is any parallelism between the heavy concentrations of this Ark at the pre-ceramic level of the Palmer Midden and the presence of Donax, the coquina, at the pre-ceramic level at the Cotton Site, along with the associated speculations as to geophysical changes referred to at the Cotton Site and the resulting transition from coquina to oysters.

FAMILY - OSTREIDAE

Genus Ostrea Linne. 1758

Crassostrea (Ostrea) virginica Gmelin — Virginia Oyster P. 95

TEST I

DEPTH IN INCHES	TOTAL COUNT	AVERAGE SIZE LNGTH X WDTH (by cm.)	MAX. SIZE LNGTH X WDTH (by cm.)	MIN. SIZE LNGTH X WDTH (by cm.)
0-12	746	5.90 X 3.30	9.33 X 5.02	3.27 X 1.68
12-24	416	6.16 X 3.77	9.10 X 4.95	3.85 X 2.91
24-36	160	5.14 X 3.45	6.79 X 4.40	3.80 X 2.71
36-48	265	5.63 X 3.02	7.60 X 3.50	3.50 X 2.20
48-60	130	5.03 X 2.91	6.05 X 4.05	4.40 X 2.30
60-72	263	5.88 X 3.31	9.00 X 3.70	3.20 X 1.90
72-84	245	5.90 X 4.03	7.20 X 4.20	4.90 X 3.81
84-96	692	6.50 X 3.77	10.80 X 5.10	4.80 X 3.64
96-108	597	5.36 X 3.02	8.61 X 3.72	2.90 X 1.81
108-120	554	5.60 X 3.35	8.00 X 4.41	3.31 X 2.80
120-132	354	5.11 X 3.21	7.20 X 4.00	3.51 X 2.50

Crassostrea (Ostrea) virginica Gmelin   Virginia Oyster

TEST II

DEPTH IN INCHES	TOTAL COUNT	AVERAGE SIZE LNGTH X WDTH (by cm.)	MAX.SIZE LNGTH X WDTH (by cm.)	MIN.SIZE LNGTH X WDTH (by cm.)
0-12	684	5.72 X 3.20	9.54 X 5.00	3.00 X 1.25
12-24	438	6.00 X 3.89	9.68 X 4.62	3.29 X 2.00
224-36	210	5.40 X 3.00	7.00 X 4.25	3.09 X 2.50
36-48	287	5.80 X 3.31	7.82 X 4.00	3.42 X 2.00
48-60	170	5.00 X 2.84	6.54 X 4.80	5.52 X 3.20
60-72	248	6.10 X 3.41	10.23 X 4.96	2.95 X 1.76
72-84	200	5.76 X 4.00	8.42 X 4.68	4.82 X 3.94
84-96	572	5.45 X 3.52	9.86 X 5.00	4.32 X 3.00
96-108	626	5.42 X 3.00	9.02 X 3.95	3.28 X 2.09
108-120	603	5.24 X 3.50	8.64 X 4.00	3.00 X 2.50
120-132	305	5.00 X 3.02	7.62 X 4.00	3.26 X 2.02

The common oyster is familiar to almost everyone. It has a rough, heavy shell that is usually long and narrow, often curved, occasionally nearly circular in outline. The upper valve is smaller and flatter than the lower. The adults often average seven to eight inches in length. Of the food mollusks available to the local inhabitants of the early middens, the oyster was not only the most readily

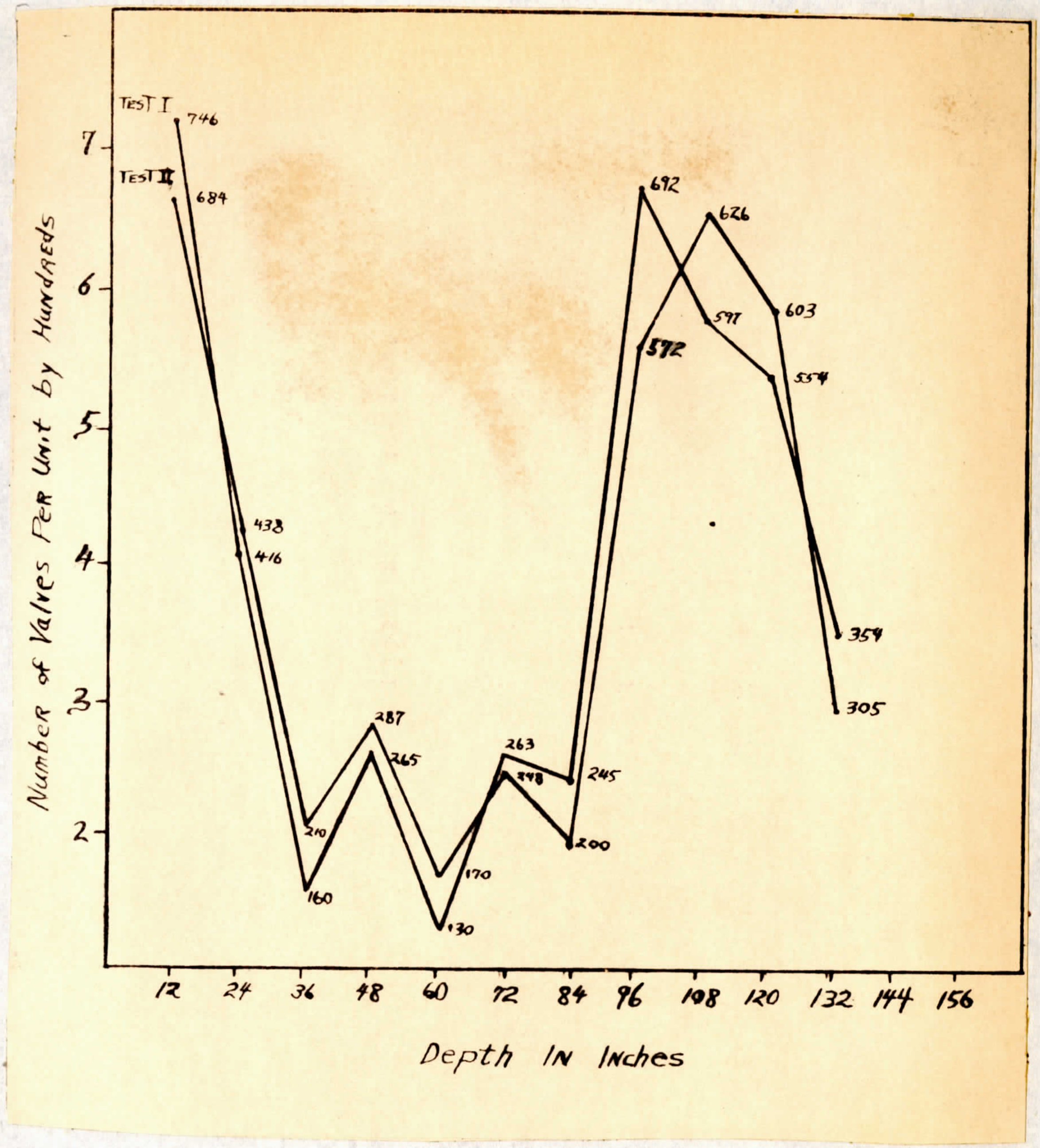


FIGURE 2

STRATIMETRIC TALLY, GENUS CRASSOSTREA
TEST I AND TEST II, PALMER SITE

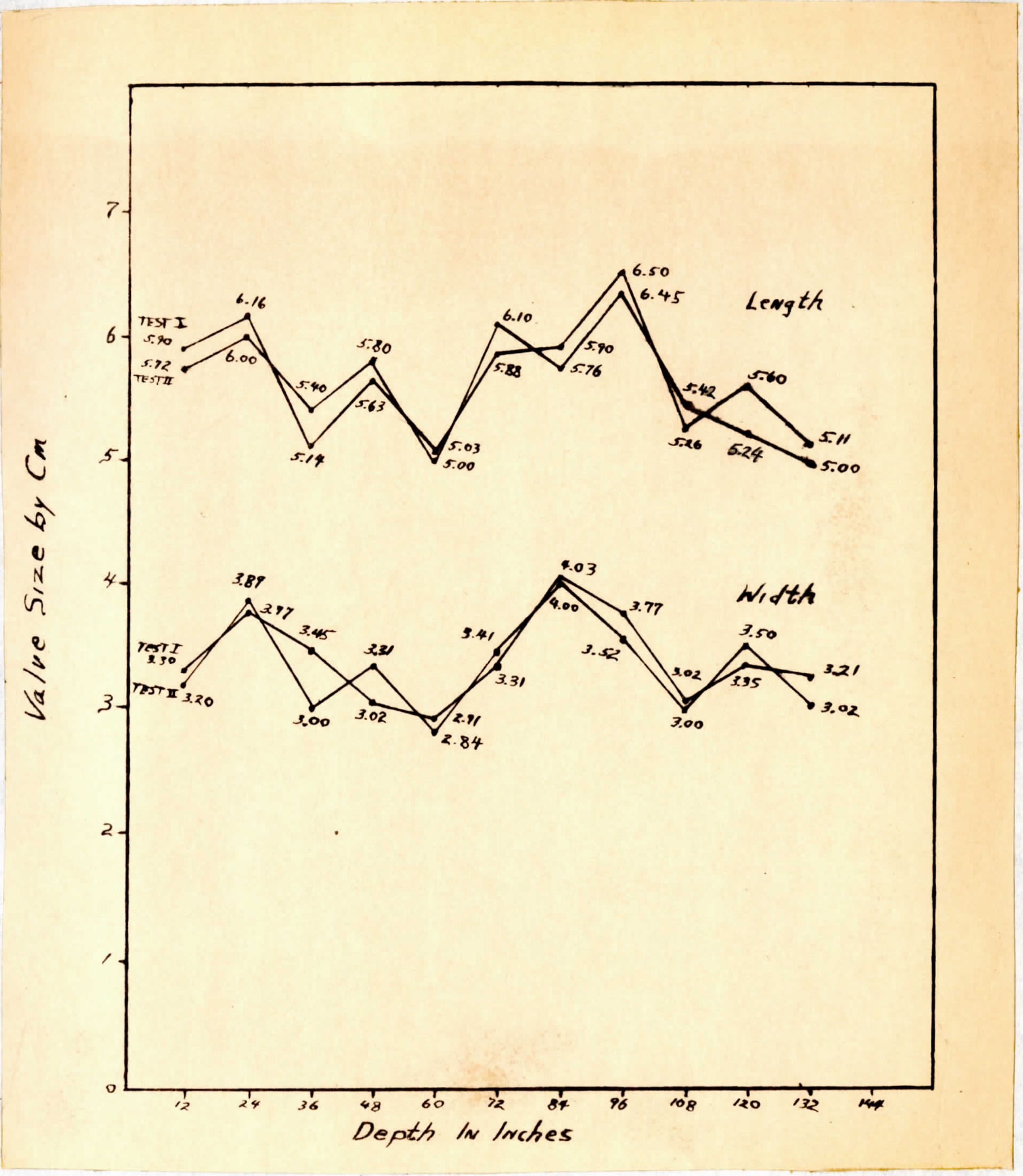


FIGURE 3

CRASSOSTREA VALVE MEASUREMENTS LENGTH BY WIDTH available mollusk but it was also the most desirable as far as taste goes.

A few of the examples recovered from the test were so small as to make positive identification between *Crassostrea virginica* Gmelin, and *Ostrea frons* Linne. difficult. The Crassostrea group are the most desirable for food however, are larger in size than *Ostrea frons*, and it is likely that very few "Coon Oysters" were present. Ecologically, they both respond to the same estuarine environment stimuli.

The total count per unit level may at first seem excessively high. It should be noted, however, that with the generic groups *Crassostrea*, *Pectin*, and *Venus* in particular, there is a tendency for the valves to stack neatly, one within the other. This easily produces a high total count in a limited area.

When analyzing the changes in size that occurred or did not occur with changes in depth, it is the author's opinion that the very slight changes have significance. Depth 84"-96", for example, showed an increase in the average length over the valves from other depth units. This increase is of a degree that warrants an assumption that certain levels of the midden reflect ecological-environmental change.

FAMILY - CARDIIDAE

Genus Dinocardium Dall 1900

Dinocardium robustum Solander — Great Heart Cockle P. 97

DEPTH IN INCHES	SHELLS PER SAMPLE TEST I	TEST II
0-12	20	12
12-24	10	6
24-36	3	10
36-48	4	8
48-60	2	0
60-72	0	2
72-84	3	1
84-96	0	0
96-108	0	1
108-120	0	0
120-132	1	0

The Cockle Shell is the largest member of the Cardiidae family. It averages between three and six inches in length and nearly as much in width. It is a dweller of sandy bottoms and frequently forms large beds at the mouths of creeks or estuaries. It is, therefore, not surprising that twenty complete or nearly complete specimens were collected from one unit (0"-12") alone. It is somewhat significant that the total count of this mollusk drops to zero on several occasions in the test columns. It can only be assumed that the drop in count on this shellfish is in some way associated with the similar drop in the count of *Arca pexata* and *Arca secticostata* and represents a response to an environmental change, which is discussed in a later chapter.

The form collected at the Palmer Site was probably the larger variety, *Dinocardium robustum vanhyningi* Clench and Smith, which is more typical of the Florida Gulf Coast. This mollusk is usually found in any situation suitable to the Virginia Oyster.

Genus <u>Trachycardium</u> March 1853

<u>Trachycardium</u> <u>muricatum</u> Linne. Common Cockle
P. 96

DEPTH IN INCHES	SHELLS PER SAMPLE TEST I	TEST II
0-12	2	0
12-24	0	3
24-36	0	0
36-48	0	1
48-60	0	3
60-72	0	0
72-84	0	1
84-96	0	1
96-108	2	0
108-120	0	0
120-132	2	4

This pelecypos measures from one to three inches in length and is readily identified by its nearly central beak, sharply scaled ribs, and serrated interlocking valve margins. It lives in sand below the low tide mark and is often associated with the same habitat as the Bay Clam. Since it was present in the tests only in small numbers, and was located at divergent depths, it is probable that its inclusion in the midden refuse represented randon collection along with scallops and clams in particular.

FAMILY - PECTINIDAE

Genus Pectin Osbeck 1765

Pectin irradians Lamarck

Bay Scallop
P. 96

TEST I

DEPTH IN INCHES	TOTAL COUNT	AVERAGE SIZE LNGTH X WDTH (by cm.)	MAX.SIZE LNGTH X WDTH (by cm.)	MIN.SIZE LNGTH X WDTH (by cm.)
0-12	699	4.15 X 4.19	5.84 X 5.75	3.33 X 3.42
12-24	375	4.94 X 5.06	7.23 X 7.64	3.16 X 3.09
24-36	112	4.62 X 4.61	5.31 X 5.30	3.81 X 3.78
36-48	263	5.20 X 5.22	5.40 X 5.62	4.40 X 4.10
48-60	110	4.86 X 4.97	5.90 X 5.70	3.70 X 3.80
60-72	565	4.96 X 5.03	5.63 X 5.22	4.42 X 4.63
72-84	462	5.40 X 5.39	6.80 X 6.90	4.10 X 4.25
84-96	781	4.42 X 4.77	6.32 X 6.54	3.90 X 3.82
96-108	576	4.76 X 4.87	6.30 X 6.42	3.60 X 3.61
108-120	456	4.68 X 4.81	5.91 X 6.00	3.74 X 3.92
120-132	365	4.77 X 4.78	6.30 X 6.42	3.71 X 3.60

<u>Pectin</u> <u>irradians</u> Lamarck Bay Scallop

TEST II

DEPTH IN INCHES	TOTAL COUNT	AVERAGE SIZE LNGTH X WDTH (by cm.)	MAX.SIZE LNGTH X WDTH (by cm.)	MIN.SIZE LNGTH X WDTH (by cm.)
0-12	524	4.28 X 4.35	5.62 X 5.70	3.61 X 3.63
12-24	306	4.65 X 4.82	6.65 X 6.72	3.74 X 3.95
24-36	124	5.03 X 5.35	6.63 X 6.48	3.18 X 3.21
36-48	195	5.38 X 5.41	5.82 X 5.80	3.57 X 3.60
48-60	86	4.95 X 5.01	5.62 X 5.60	3.76 X 3.86
60-72	590	4.85 X 4.92	5.68 X 5.25	4.38 X 4.57
72-84	506	5.10 X 5.08	6.90 X 6.92	3.72 X 3.65
84-96	692	4.68 X 4.63	6.36 X 6.38	3.80 X 3.78
96-108	580	4.72 X 4.88	6.00 X 6.01	4.15 X 4.20
108-120	526	4.52 X 4.63	5.82 X 5.91	3.32 X 3.41
120-132	392	4.96 X 4.98	5.84 X 5.86	3.70 X 3.86

The same features observed with the oysters were noted with the Bay Scallop. This shellfish was the second most numerous genus. Here again, the Bay Scallop, like the oyster, is a bottom dweller confined to shallow water. The Scallop group does require or prefer a slightly cleaner, more saline, and grassy situation.

Here again, the size averages reflect moderate change, perhaps indicative of some ecological change. The total

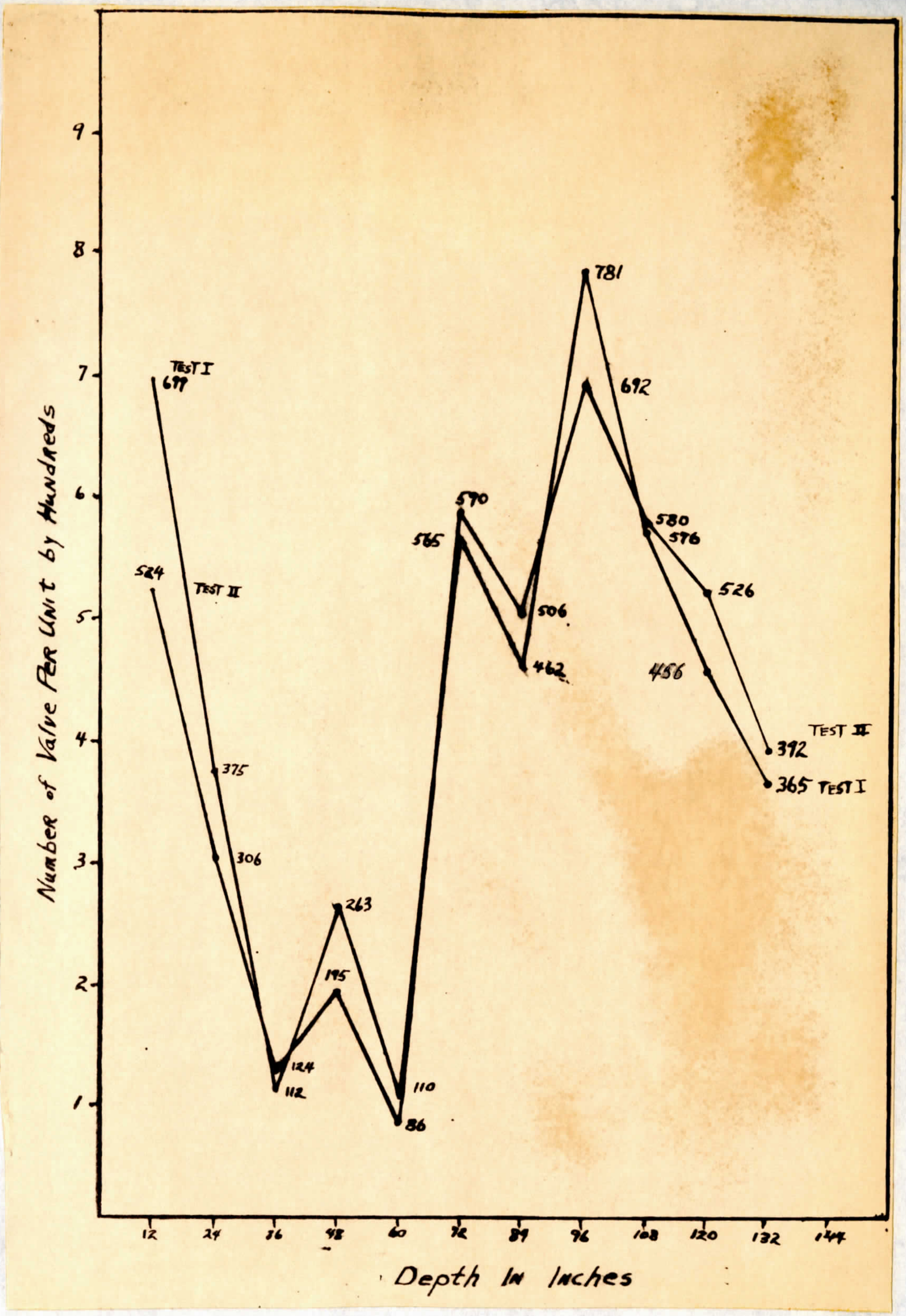
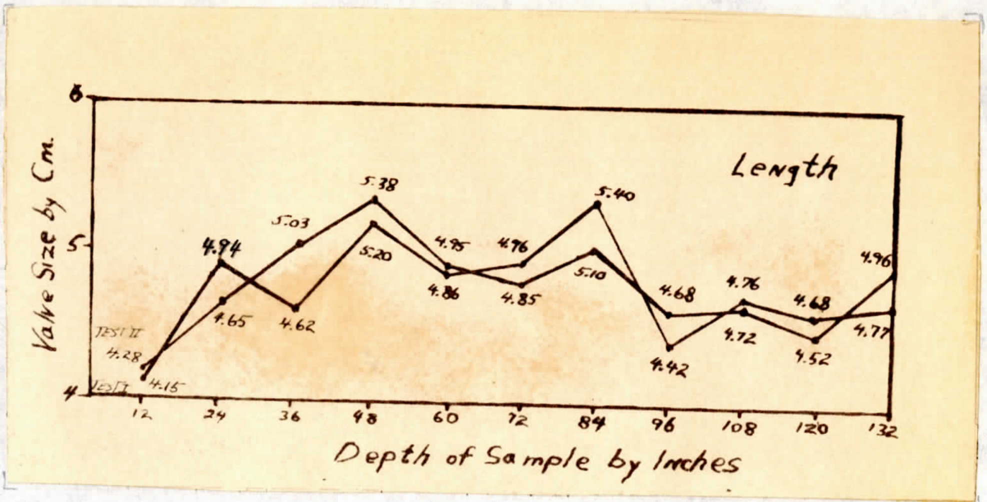


FIGURE 4

STRATIMETRIC TALLY, GENUS PECTIN, TEST I AND TEST II, PALMER SITE



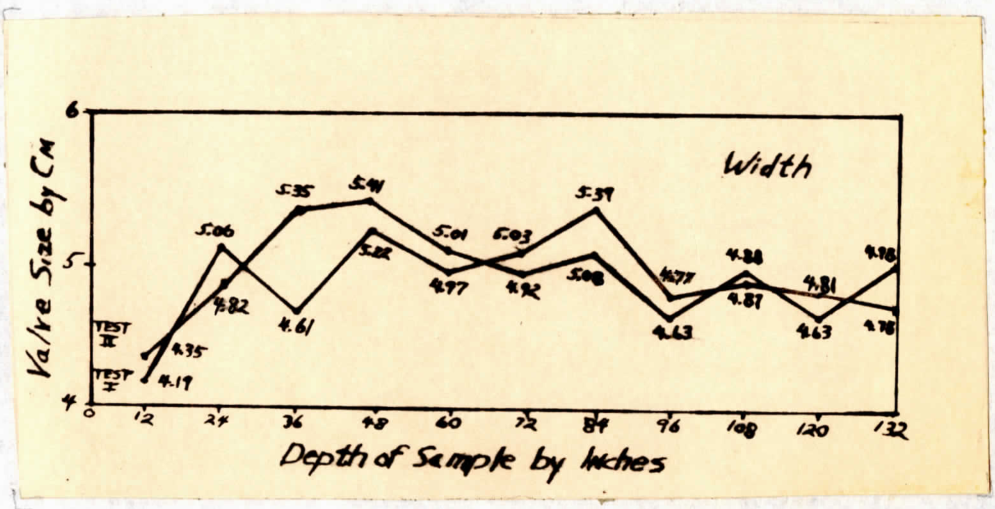


FIGURE 5

<u>PECTIN</u> VALVE MEASUREMENTS, LENGTH BY WIDTH

count by depth unit and the changes noted are also indicative of some environmental alteration. As mentioned previously, the possible causes of these population-count shifts and the variations in size average will be discussed in the following chapters.

The Bay Scallop is a medium sized bivalve. The average length of the present day commercially harvested individuals is about three inches, with the valve usually being slightly wider than it is long. This mollusk and its close relatives are very unusual in that they possess functional eyes. The swimming action is most unusual, with propulsion created by a rapid opening and closing of the valves. The water forced out of the closing valves propels the scallop along in a jet-like manner.

FAMILY - VENIRIDAE

Genus Macrocallista Meek 1876

Macrocallista nimbosa Solander — Sun Ray Clam P. 95

DEPTH IN INCHES	SHELLS PER SAMPLE TEST I	TEST II
0-12	3	1
12-24	1	3
24-36	0	2
36-48	2	0
48-60	2	0
60-72	0	1
72-84	7	0
84-96	0	1
96-108	3	3
108-120	5	3
120-132	6	7

It is interesting to note that the Sun Shell was not present in larger numbers. Although numerous in Little Sarasota Bay at the present, perhaps it was not so during the construction phases of the midden. Another possible factor is that this pelecypod must be dug from the sand bars. The plentiful supply of those more easily accessible shellfish would have eliminated the need for this more difficult to obtain, although desirable mollusk.

There is evidence as to the use of the Sun Shell by the early Indians of Florida as a knife. This shell is large and ovoid, with a smooth, sharp, thin edge, occasionally exceeding six inches in length.

Genus Venus Linne. 1758

Venus (Mercinaria) campechiensis Gmelin   Southern Bay Clam
P. 97

DEPTH IN INCHES	SHELLS PER SAMPLE TEST I	TEST II
0-12	70	56
12-24	49	62
24-36	52	40
36-48	39	28
48-60	16	22
60-72	5	3
72-84	8	6
84-96	13	4
96-108	8	6
108-120	12	17
120-132	27	12

Venus campechiensis Gmelin is a bivalve closely related to, but larger and thicker than, the Common Quahog (Venus mercinaria Linne.). A large percentage of the valves present in Test I and II were small individuals. This is understandable to anyone who has attempted to eat a maximum sized individual. Needless to say, they are excessively tough. The total count in the test depth units was made by counting either valve spires or by combining a number of fragments roughly equal to one complete valve in many cases, for it was rather infrequent to find a complete, unbroken valve.

This clam averages approximately six inches in length, has an exceptionally thick shell, and, in fact, owing to its rugged construction, was often used as an anvil by the local Indians. Its shell (Venus mercinaria--not Venus campechiensis) was used by the Indians from New England through the Carolinas as the raw material for beads, the famous "Purple Wampum" for example. In Florida it (Venus campechiensis) was less frequently used in such a manner.

CLASS - GASTROPODA

FAMILY - CREPIDULAE

Genus Crepidula Lamarck 1799

Crepidula fornicata Linne. Boat Shell
P. 98

Only six examples of this small gastropod were located in Test I. Two occurred in depths 0"-12" and four in depths 120"-132". Seven examples were found in Test II. Three of these were in depth unit 24"-36" and four were in depth units 120"-132".

The Boat Shell is a small gastropod from one to one and one-half inches long. It is frequently found in clusters adhering to clumps of oysters, and the appearance within the midden refuse would represent individuals brought ashore as an inclusion in the harvested oysters.

The natural range of this gastropod is from Nova Scotia to the Gulf of Mexico.

FAMILY - FASCIOLARIIDAE

Genus Fasciolaria Lamarck 1801

Fasciolaria gigantea Riener Horse Conch

Only two specimens of the Horse Conch were found in Test I, one in the depth unit 84"-96" and the other in depth unit 120"-132". Three were recovered from Test II. One of these was in depth unit 60"-72" and the remaining two were from the 108"-120" level and the 120"-132" level respectively.

Although only five examples of this gastropod were collected, examples of it have been found spread at random in almost all areas of the State Museum's original pit. This is a very large gastropod which one would not expect to be concentrated in the midden, for it is only relatively abundant in the shallow waters of bays and estuaries from the Carolinas to Brazil.

The Horse Conch is carnivorous and kills its prey by overpowering and smothering. It has the distinction of sharing the honor of being the largest univalve in the world with its close relative Megalotractus aurunanus Linne., which is a native of Australia.

Fasciolaria tulipa Linne. Tulip Shell P. 98

DEPTH IN INCHES	SHELLS PER SAMPLE TEST I	TEST II
0-12	36	12
12-24	16	22
24-36	3	7
36-48	11	5
48-60	2	0
60-72	4	2
72-84	3	6
84-96	0	4
96-108	2	0
108-120	0	1
120-132	6	9

The Tulip Shell normally averages four to six inches in height with eight-inch specimens not uncommon. The majority of the specimens collected at the Palmer Site were immature individuals. This snail occurs from the Carolinas to Texas and lives from the shore line out to fairly deep water. In the area of Little Sarasota Bay it is found frequently on the shallow grassflats today and is commonly associated with the Bay Scallop.

A fairly large amount of meat is contained in this mollusk and the number of specimens collected in the tests represents, in relationship to the total numbers of other genera of gastropods available, evidence that this snail was heavily collected during the chronological periods involved in the construction of the upper portions of the midden. It should also be noted that small individuals were collected, probably because of the toughness of the maximum individuals.

FAMILY - MURICIDAE

Genus *Murex* Linne. 1758

Murex pomom Gmelin

Apple Murex
P. 102

DEPTH IN INCHES	SHELLS PER SAMPLE TEST I	TEST II
0-12	8	6
12-24	9	12
24-36	0	4
36-48	1	6
48-60	0	1
60-72	0	1
72-84	0	0
84-96	0	0
96-108	0	0
108-120	0	0
120-132	0	0

The Apple Murex is a small spiny gastropod ranging from the Carolinas to Venezuela and found on both rocky and sandy bottoms in shallow to deep water. It is carnivorous and very predaceous, at times a scavenger, and is plentiful on Florida beaches. As far as its being sought after for food, it would be reasonable to explain its presence in limited numbers (in the midden material) as a lack of need or demand rather than a lack of individuals to collect. It is definitely not rare at the present date.

Once again, it is interesting to note the absence of a sandy-bottom dweller in the deeper layers of the midden.

This mollusk may have been collected for its attractive shell. In all likelihood, however, such was not the case, for artifacts manufactured from its shell have not, to the author's knowledge, been recorded from the area surrounding and including Little Sarasota Bay.

FAMILY - NATICIDAE

Genus Polinices Montfort 1810

Polinices duplicata Say — Lobed Moon Shell P. 101

One example of the Lobed Moon Shell was recovered from Test I. This specimen was associated with depth 0"-12". No examples of this mollusk were found in Test II.

The Lobed Moon Shell snails are predatory gastropods about two inches in height and nearly three inches in diameter. This shellfish is very common in the shallow mud flats of the bays and estuaries of Sarasota County, and while it is not a large animal, its frequency would attract attention and certainly lead to its inclusion in any shellfish harvest. Its rarity in the test pits is therefore somewhat of a puzzle. It is entirely possible that the taste or flavor makes it undesirable; the author could find no authority to this speculation.

This snail was somewhat valued for its attractive shell, for occasional specimens are found with suspension holes drilled through the outer edge of the lip in order that it might be strung as a bead or ornament.

The natural range of this mollusk is from Maine to Florida.

FAMILY - NEPTUNEIDAE

Genus Busycon Botten 1798

Busycon perversum Linne. Lightning Conch
P. 99

DEPTH IN INCHES	SHELLS PER SAMPLE TEST I	TEST II
0-12	20	12
12-24	18	22
24-36	21	15
36-48	19	25
48-60	8	6
60-72	3	1
72-84	4	0
84-96	6	3
96-108	2	5
108-120	0	2
120-132	2	0

The Lightning Conch is very large and is reasonably common along the tidal beaches and grass flats of the Central Florida Gulf Coast. This gastropod quite frequently attains a size in excess of ten inches in height although most of the examples in the test units were well under seven inches. Here, again, the choice of the small individuals is obvious. In this genus, the muscle of the foot is large and quite acceptable in flavor. It tends to become very tough in the large specimens but may be pounded or ground to produce stock for a very fine chowder. The shell was one of the most important sources of raw material for tools and ornaments.

The complete and most often referred to name of this conch is _Busycon perversum kieneri_ Phillipi.

The reduction in count by depth in the test units is again rather difficult to explain. This conch is a typical find in the more recent middens of the Florida Gulf Coast, the specimens usually being of very large size. No authority could be located dealing with the presence of this shellfish in the middens of the Mt. Taylor and the Orange Periods, although Goggin reports _Strombus_ and _Busycon_ tools typical in the early middens along the St. John's River.[27]

Busycon perversum is unusual on the Atlantic Coast, being more typical of the Gulf, and it is rare north of Cape Hatteras.

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[27] John M. Goggin, "Space and Time Perspective in Northern St. John's Archeology, Florida," _Yale University Press_, No. 47. New Haven.

Busycon pyrum Dillwyn

Fig Shell
P. 98

DEPTH IN INCHES	SHELLS PER SAMPLE TEST I	TEST II
0-12	6	12
12-24	10	9
24-36	1	3
36-48	17	12
48-60	6	9
60-72	3	0
72-84	0	0
84-96	1	0
96-108	4	2
108-120	6	7
120-132	3	2

The Fig Shell is a fairly large (three to five inches high) member of the family Neptuneidae and is common in the same situation as Busycon perversum. It is not as numerous as the Lightning Conch, however, nor does it contain as much meat. It would be collected whenever found and would be a natural inclusion in the midden refuse.

The normal range of the Fig Shell is from Cape Hatteras to the Gulf of Mexico.

Genus Melongena Schumacher 1817

Melongena corona Gmelin

Crown Conch
P. 100

DEPTH IN INCHES	SHELLS PER SAMPLE TEST I	TEST II
0-12	8	6
12-24	9	6
24-36	0	2
36-48	1	0
48-60	0	0
60-72	0	0
72-84	0	1
84-96	0	0
96-108	1	0
108-120	0	2
120-132	4	3

Although smaller than the Lightning Conch or the Fig Shell, the Crown Conch is more numerous than either of the others. It has a small foot with barely a sufficient amount of meat to be worthwhile collecting even in large numbers, particularly when more desirable species were present. Evidently, such was the case in Little Sarasota Bay.

The small number of individuals spread evenly throughout the test depths indicates this gastropod was present in relatively constant numbers in the local bays over a long period of time.

Its natural range is muddy, brackish water throughout the marine habitats of Florida.

The Crown Conch is an active predator of the Coon Oyster, and would be a natural association with oyster beds.

FAMILY - STROMBIDAE

Genus Strombus Linne 1758

Strombus alatus Gmelin — Florida Conch
P. 98

DEPTH IN INCHES	SHELLS PER SAMPLE TEST I	TEST II
0-12	35	28
12-24	31	15
24-36	11	20
36-48	42	22
48-60	48	30
60-72	23	15
72-84	50	38
84-96	26	30
96-108	35	15
108-120	52	46
120-132	30	10

The Florida Conch is a heavy bodied, strong gastropod three to five inches in height. It is very common on the Gulf Coast and is often confused with the West Indian Fighting Conch (Strombus pugilis Linne).

These snails are found in shallow mud or grass flats and are active carrion-eaters. The flesh was evidently utilized, considering the relative high numbers of the shells present in the samples, but in addition to its use as food, the shell of the Florida Conch was often used as a tool. In this case, a hole was punched or ground through the body of the shell, a handle inserted, and the apex of the spire used as a hammer-head.

CHAPTER IV

A CRITICAL ANALYSIS OF THE MIDDEN REFUSE

It was unfortunate that radiocarbon dates were not available for every cubic foot unit in both Test I and Test II. It therefore became necessary to assign hypothetical dates to certain units. These dates were considered to be backed with enough archeological information to be considered valid. No evidence was found that would support possible arguments in favor of other chronological interpretations concerning these depth units, not having carbon 14 dates.

I. INTERPRETATIONS OF THE SAMPLE DEPTH UNITS

0-12 Inches. According to Bullen's article concerning the Palmer Site, and in reference to Figure 6, the date assigned to the bottom of depth unit 0-12 inches was 1390 B. C. ± 120 years.[28] This date and the twelve-inch level was associated with a type of fiber-tempered pottery known archeologically as Early Decorated, Fiber-tempered, or Orange Incised pottery. The ceramic type found above the twelve-inch level was a rough, sand-tempered ware usually

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[28] Ripley P. Bullen, "Radiocarbon Dates," loc. cit.

Period	Site	Radiocarbon Date B.C.
Transitional	Chattahoochee R. J-5-Fla.	1195
Late Decorated Fiber-tempered	Cotten	1065
Early Decorated Fiber-tempered	Palmer 0-1ft.	1390
	Palmer 2-2.5ft.	1265
Plain Fiber-tempered	Palmer 4ft.	1615
	Palmer 8ft.	2090
Preceramic	Palmer 11ft.	2140

FIGURE 6

RADIOCARBON DATES FOR CERAMIC SEQUENCES
PALMER SITE

designated _Transitional_ pottery. _Transitional_ pottery, in this geographic area, is more recent than _Orange Incised_ and has a chronologic age of approximately 1000 years B. C. This represents a time spread for the deposition of depths unit 0-12 inches, of 390 ± 120 years, or a terminal date for the abandonment of that specific portion of the midden involved with Test I and Test II of 1000 B. C. ± 120 years. We may therefore say that the surface of both tests (which was actually about two inches below ground surface) was deposited at approximately 1000 B. C.

The mollusk shells collected in depth unit 0-12 inches reflected an economy based primarily upon the selective gathering and consumption of various pelecypods and gastropods. These were represented most heavily by the Virginia Oyster (_Crassostrea virginica_ Gmelin), the Bay Scallop (_Pectin irradians_ Lamarck), various conches and whelks, and the Southern Bay Clam (_Venus campechiensis_ Gmelin). Several minor molluscan groups were also harvested, if not for food for tools or ornaments.

12-24-36 Inches. The time span covered by depth unit 12-36 inches was difficult to estimate. The available radiocarbon date involved the 12-30 inch depth. This unit was characterized, as was the lower level of depth unit 0-12 inches, by _Orange Incised_ pottery. Shell samples from this zone produced a date of 3225 ± 120 years B. P. (as of the radiocarbon test date of 1960 A. D.), or approximately 1265 B. C.

At first glance, the dates and ages given for depth unit 0-12 inches (3350 ± 120 years B. P. or 1390 B. C. as of 1960), and 12-30 inches (3225 ± 120 years B. P. or 1265 B. C. as of 1960 A. D.), seem to contradict one another. It would obviously be impossible for an undisturbed deeper test zone to be more recent than a surface zone. If, however, one considers the 120 year leeway granted in the interpretation of the radiocarbon dates for both depth units, the final analysis would produce a reasonable chronology. For example, for depth unit 0-12 inches, 3350 - 120 years B. P. as of 1960 A. D., would produce a date of 1270 B. C., while depths 12-30 inches might be associated with the date of 3225 + 120 years B. P. as of 1960 A. D., or 1385 B. C. This would produce a passage of 115 years for the construction period involved in the deposition of the shells in the 12-30 inch level.

When considering the numbers and the types of mollusks represented in the analysis of Test I, and Test II, a noticeable drop in count occurred in units 12-24 inches and in 24-36 inches. These depths, 12-36 inches, were different from unit 0-12 inches in several ways. For example, there was considerably more humic material and sand in unit 12-36 inches than in the previous level. This increase in earth plus the noticeable decrease in most mollusk genera would stand to reason if we were to consider the possibility of a smaller number of people involved in the construction phase of this particular part of the midden. Figures 2 and 4 graphically illustrate the stratimetric changes involved in Test I and Test II as pertains to the genera Crassostrea and Pectin.

A smaller population would certainly reduce the concentration of material for specific areas of the midden. For other areas, such as those areas immediately associated with dwellings, however, the concentration of shells might be quite heavy. We can therefore say, that for the immediate area of the test units, several possibilities are available. One possibility would be that the population involved with depth unit 12-24 inches and 24-36 inches was less dense than during later times, when depth unit 0-12 inches was being laid down, or, another possibility is that there was a lower mollusk population for the area during the time period involved. A third possibility is that there was a large human population that over-harvested, thereby reducing the total number of mollusks available.

It does not seem likely that a population of any size would continue to live in an area depleted of shellfish for such a long period of time without moving to a new and more productive location unless the environmental situation had been altered in such a way as to deplete the shellfish over a widespread area. A severe or prolonged climatic change could bring about such results, provided the change was to the detriment of the molluscan populations.

Little concrete evidence appeared through depth units 12-24 inches to indicate any outstanding ecological change in the area concerned although Figure 3 illustrates a reduction in the average size of the genus Crassostrea starting at the depths 24-36 inches. Figure 5 shows a generalized size reduction (Test I but not Test II) in the genus Pectin at the same depths. This reduction in size possibly represented a response to a change in the environment that was more detrimental to the oysters than to the scallops.

36-48 Inches. The radiocarbon date assigned to these depths would be 1615 B. C. or 3575 ± 120 years B. P. (as of 1960), at the four foot line. This four foot or forty-eight inch date also represents a period of shift from the use of the early type of non-decorated fiber-tempered pottery to the decorated variety. The time involved in the deposition of the test units within this 36-48 inch level would have been approximately two hundred to three hundred years.

In depths 36-48 inches the concentration of shells increased, as is noted in Figures 2 and 4. Loose earth was not as evident as before, but one concreted mass of oyster and scallop shells, weighing two pounds and seven ounces was found. The shells in this mass were cemented together by the action of water on burned or calcined materials. The loose shells present in these levels were much cleaner than in previous test units and were invariably whole specimens.

The increase in the total count of the shells present and their clean condition indicated that they were deposited rapidly, little time being allowed for the formation of humus. All of this indicates a larger population present for this portion of the midden during this phase of construction. The Figures associated with the size and abundance of the genera Crassostrea and Pectin (Figures 2-5) show an elevation in the numbers of the valves present. In addition to this was an increase in the size average for each type in the depth units for both Test I and Test II. This increase in size and number represents evidence of an environmental change favorable to the oyster and scallop population in the immediate area. If simply an increase in harvesting by an enlarged human population were involved, the results of the stratimetric chart would obviously show a rise in count, but the charts or figures for average measurement would not show an increased average size in both Test I and in Test II. Considering the length of time involved in the deposition of depth unit 36-40 inches--approximately two hundred years--the physiographic changes which occurred were rather prolonged.

48-96 Inches. The radiocarbon date assigned to the 96 inch level was 2090 B. C. or 4050 ± 125 years B. P., 1960. This represents a construction period of 475 years for the deposition of depths 48-96 inches. This time spread also represents the culture phase of the midden's growth characterized by the use of plain, undecorated fiber-tempered pottery (Orange Plain). Between 48-60 inches there was a noticeable decline not only in the total number of shells of certain species but also in the over-all size (length versus width) of the valves of *Crassostrea*. Figures 2 and 3 show the relationship in the drop in total number of oyster valves present and the associated drop in valve size. Figures 4 and 5 demonstrate that these changes did not apply to the genus *Pectin* as vividly. While it was again impossible to determine the cause of this size-volume reduction it is reasonable to say that such correlated changes were the result of an environmental change, detrimental to both oysters and to a lesser degree scallops, and which would without a doubt affect the level of human population residing at the Palmer Site.

It is known that the food gathering habits of the inhabitants of some of the Florida middens were seasonal.[29]

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[29]Ripley P. Bullen and Frederick W. Sleight,

In the cases referred to by Bullen and Sleight, it was noted that the harvesting of oysters, in particular, was restricted to the months extending from September through April. Two basic reasons for this seasonal gathering are given: (1) As mentioned previously in this paper, oysters are supposedly more palatable in the winter months; (2) there is also the aspect of summer toxicity on the part of many shellfish, owing to their feeding on such dinoflagellates as Conyaulax. Poisoning by the consumption of these shellfish can result in paralysis.[30]

Although the reasons stated above would possibly be valid for seasonal gathering, the author of this investigation could find no reason to consider seasonal gathering as influental in the variations noted at the Palmer Site. One reason for this would be the long time span covered in the observable changes. It is debatable that the Indians of the periods of time covered at the Palmer Site were bothered by shellfish summer toxicity.

From 60-96 inches the stratimetric charts (Figures 2 and 4) for both Crassostrea and Pectin show a great increase

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"Archeological Investigations of the Castle Windy Midden, Florida," William Bryant Foundation of American Studies, Vol. I, (1959), 29.

[30] Ibid.

in the number of valves recovered. Figure 3 also shows an increase in the average size of the oyster valves, but Figure 5 does not show any appreciable increase in the scallop valve size. The situation is similar to that observed in depth units 36-48 inches. Whatever the causal factor, the scallop group was obviously not affected as greatly as the oysters.

96-132 Inches. The depth of ninety-six inches brings into evidence a preceramic culture. The only radiocarbon date available for this culture zone is 2140 B. C. or 4100 ± 125 years B. P., as of 1960 A. D.

From 96-132 inches a change in size averages and in total count occurred that was extreme enough to represent valid evidence of ecological or environmental change. Until the 96-inch level was reached (proceeding from past to present), Arca transversum was common; both Crassostrea and Pectin irradians were increasing in size and number. But after the 84-96 inch level, i.e., coming up towards present, Arca transversum disappeared completely in both test units. It should be noted in Figures 2 through 5, that Crassostrea and Pectin decreased in size and number and did not increase again until a slight rise was noted at the 84 inch depth, the 60 inch depth and again at the 36 inch depth. By the 72 inch level, two other species of Ark (Arca pexata and Arca secticostata) had made their appearance and Dinocardium and Busycon perversum were on the increase.

II. ANALYSIS OF THE QUANTITATIVE AND QUALITATIVE VARIATIONS IN THE SAMPLE UNITS

As stated by Neill, the disappearance of Arca transversum, followed by the appearance of Arca pexata and Arca secticostata, is revealing.[31] Arca transversum is a mud bottom dweller, as opposed to the other two Arks, which inhabit sandy or rocky bottoms. The disappearance of Arca transversum in relatively large numbers is indicative of an environmental-climatic change which converted Little Sarasota Bay from a basically mud bottom to an environmental situation in which the bottom was primarily sandy. This sandy bottom would also tend to create a situation in which the baywater transported fewer shell forming minerals, resulting in a reduction in valve size of the oysters and scallops. The cause of these environmental changes is at present rather hypothetical. Based on information suggested by Neill,[32] the environmental-ecological changes were the result of cyclic changes in temperature plus a corresponding fluctuation in sea level.

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[31] Wilfred T. Neill, personal communication.

[32] Ibid.

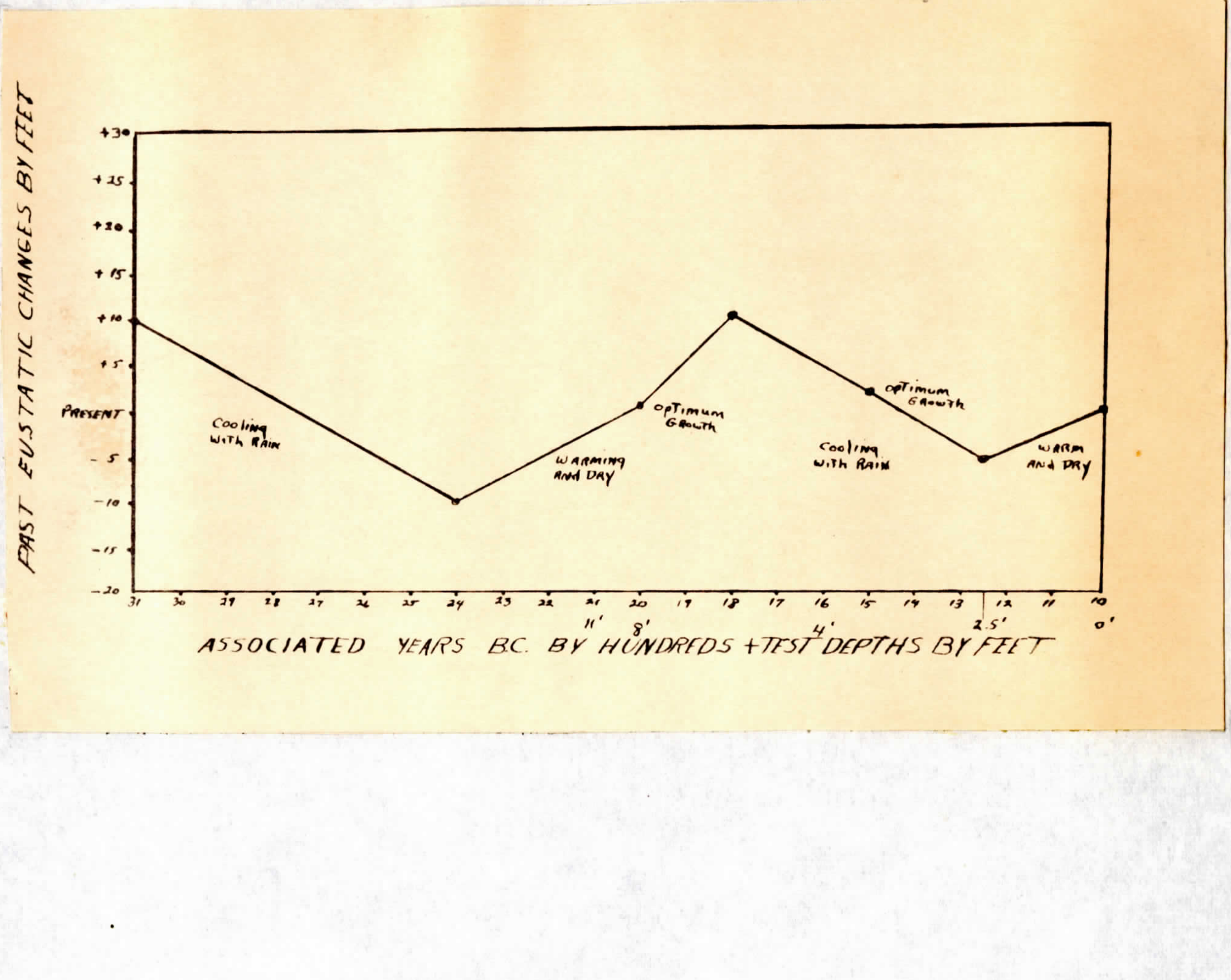

FIGURE 7

THEORETICAL CYCLIC, POST-GLACIAL SEA LEVEL FLUCTUATIONS

Figure 7, based on Neill's suggestions, represents the periodic fluctuations in temperature and rainfall, with the associated rise and fall in sea level which resulted from the binding up and release of water in the polar ice-caps.

In Test I and II, the 84-96 inch level is indicative of a climatic warming trend which started approximately 2400 B. C. This warming trend was characterized by a period of melting ice-caps, less rain, and a rise in sea level which ultimately reached ten feet above the present level at approximately 1800 B. C. (the midden height at this occupation period was sufficient to be above the high tide mark). The influx of rising, saline waters into the previously brackish bay progressively reduced the phosphatic shell-building minerals that had leached into the local bays and estuaries during the previous high-rainfall, low sea-level, cool period (during these cool cycles the level of the seas would drop because of the enlargement of the polar ice-caps). This gradual reduction in the mineral content would eventually cause a reduction in the valve size of the mollusks and would possibly reduce the total population. We would, therefore, expect during the warming phase, from 2400 B. C. to approximately 1800 B. C., the mollusk, valve-minerals to reach an optimum concentration, with the valve size and count reaching a maximum peak from about 2100 B. C. through

1900 B. C., or at the eight-foot (96 inch) depth. The once very brackish bays would reach this optimum condition conducive to mollusk growth as sea waters invaded in an ever-increasing volume. At approximately 2000 B. C. (coming towards the present) the peak optimum would have been reached, followed by a gradual reduction in the size and number of shellfish present as the bay waters became excessively saline and reduced in phosphates.

After such a warm period, climaxing at about 1800 B. C., or at approximately the 60-inch depth, a cooling period commences.

During this cool phase the previously highly saline waters would progressively become diluted by the run-off of highly phosphatic ground waters, which resulted from the increasing rain. This dilution of the saline bay waters would be hastened by the lowering of the sea level in correlation to the previously mentioned binding up of the waters by the enlarging polar ice-caps. Silting would result from the erosional processes of the rain and the reduced tidal flow. An optimum growth period would again be created at the four-foot depth, or about 1600-1500 B. C.

The presence of the muddied bottom situation during the optimum period represented by depth units 96-132 inches would possibly justify or explain the presence of *Arca transversum* at these levels. At other levels, the 72-30 inch levels, the "muddy" cycle evidently did not occur long enough for the re-establishment of an "Arca transversum level." The explanation for this lack of an "upper-level" or more recent Arca transversum stage, is open for additional research although it will be partially explained in the author's conclusions.

III. AN INTERPRETATION BASED ON THE CLENCH SUGGESTION

According to Clench[33] the changes that appear in scallop and oyster valve size and number and in the disappearance of Arca transversum in the depth units extending from the 132 inch depth to the 60 inch depth were possibly due to a change in salinity. These salinity changes would not necessarily have to involve both a rise and a fall of the oceans level; a continued, gradual rise would produce the same results--marine waters gradually invading the bays (the comparison of the Palmer Site with the Cotten Site would appear more valid than at first supposed). In such cases, the periodic temperature changes with their influence on increasing and decreasing the annual rainfall as suggested by Neill would still be valid even without the polar ice-cap variations and their affect of producing cyclic sea

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[33]William J. Clench, Museum of Comparative Zoology, Harvard University, personal communication.

level fluctuations. The gradual eustatic changes that have occurred in Florida indicates a deepening of the oceans of at least eight feet during the last 3500 years.[34] According to information supplied by the Woods Hole Oceanographic Institute, the oceans are presently getting deeper.[35] This deepening did not necessarily apply during the period of construction of the Palmer Site, but it is likely, in view of the previously mentioned work by Bullen and Bullen, at the John's Island Site.

A carbon date on a fish weir found in Boston, buried beneath thirteen feet of blue clay was six to seven thousand years.[36] This indicates a deepening in the New England area of thirteen feet. Rounded out, this represents a deepening of two feet per one thousand years. Using this figure, and considering that the bottom of Test I and Test II date approximately four thousand years ago, the ocean level at that time would have been eight feet lower than it is now. Clench further states that such eustatic modifications would create greater alterations in Florida than along the rocky northern coasts, producing much more striking

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[34] Ibid.

[35] Ibid.

[36] Ibid.

ecological changes. These changes would greatly influence the local molluscan populations.

Even without the aspect of cyclic ocean rise and fall, as suggested in previous paragraphs, the periodic cold, wet cycles would contribute to an influx of valve-building minerals from upland limestone. This influx of minerals would still exceed the optimum molluscan requirements in time, but the succeeding dry phase, with warmer weather, would allow a reversal of trend. Gradually the tides would leach and erode the dissolved minerals out of the bottom sediments, in fact, transport the sedimentation away. This would change the bottom environment from a cool, rainy, mud bottom phase to a warm, saline, sand bottom phase similar to the situation suggested by Neill, but as stated, deleting the idea of rise and decline of the ocean's level and substituting the idea of a gradual but continual rise in sea level.

There is a great deal of undocumented, observable evidence in favor of the rise and fall of the ocean's level, with a slow but progressive over-all increase in depth. Many so-called Archaic lithic workshops are to be found inland from the present shoreline of Tampa Bay--approximately fifty miles north of Little Sarasota Bay. These workshop sites invariably appear to be located a mile or more inland, on high wind-blown dunes that may indicate old beach lines. If one were to consider that during the Archaic period the ocean level may have been as much as ten feet above the present-day level, the flat profile of most of the Florida West Coast would have resulted in the flooding of many low areas. It is also interesting to consider the possible wholesale flooding of many sites in and around the Tampa Bay area, and to the north for many miles.[37] Almost invariably these flooded sites date from the Archaic Period or earlier. An obvious increase in ocean depth has occurred. Irrespective of whether the rise in the level of the sea has occurred in a regular pattern or whether there has been a cyclic rise and fall with an over-all progressive increase in ocean depth, the results would have been the same--the environmental and ecological changes that have been examined in this investigation.

It should be noted that the lithic workshops and the submerged sites in and around Tampa Bay predate the Palmer Site. It is likely that the flooding of these sites occurred at a date in excess of six thousand years ago, and as is mentioned in the author's conclusions, a lack of

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[37] Wilfred T. Neill, "Historical Biogeography of Present-day Florida," _Bulletin of the Florida State Museum_., Vol. 2, No. 7, (1957), 201.

obvious erosion at later sites, including the Palmer Site, would tend to favor the proposed theory of gradual rise of the ocean's level rather than a cyclic rise and fall within the past four thousand years.

CHAPTER V

SUMMARY AND CONCLUSIONS

The basic problem involved in this investigation was the location of and the analysis of a precolumbian archeological site that would give a representative picture of the molluscan ecology of a specific bay and estuarine environment. This archeological site or midden should previously have been dated by the carbon-14 method in order that the site be analyzed and the information obtained correlated with known dates. After consideration, the Palmer Site or Midden, located on Little Sarasota Bay, Sarasota County, Florida, was selected as the test site. This midden had previously been tested archeologically and dated by strata, providing an open pit from which the investigator, by extending a sample and a control test down the walls of the existing pit, derived molluscan valves and aboriginal artifacts. From these recovered specimens an analysis was made of the various generic groups of mollusks collected by the Indians for the use as food and secondarily, as tools or ornaments. Following the classification of the mollusks present, an interpretation of the midden's ecological-environmental evolution was derived, based on obvious changes that occurred in speciation and in variations of valve size and total number collected. These changes were correlated with carbon-14 dates whenever possible.

Conclusion. Of the various food mollusks taken from the test units, nine pelecypods were involved, with the most frequent being the common Virginia Oyster (*Crassostrea virginica* Gmelin) and the Bay Scallop (*Pectin irradians* Lamarck). The valves of these two shellfish were measured and analyzed and were used as a primary factor in determining ecological-environmental change.

In the class *Gastropoda*, there were also nine representatives recovered, the most frequent being *Strombus alatus* Gmelin, the Florida Conch, the Fig Shell (*Busycon pyrum* Dillwyn), the Lightning Conch (*Busycon perversum* Linne), and the Tulip Shell (*Fasciolaria tulipa* Linne). The vast bulk of the molluscan remains taken from the test units were of species well recognized as desirable for food in so far as the aboriginal population was concerned.

It was noted, after the completion of the stratimetric counts and measurements for both Test I and the control test, Test II, that obvious environmental changes had occurred in certain depth units. These changes involved cyclic increases and decreases in valve size and total count per unit. The generic groups of mollusks within test depth units 96-132 inches reflected a size change indicative of a cool, shallow, mud or silt bottom phase in the ecological evolution of Little Sarasota Bay. During this early phase a gradual increase in the phosphate content of the bay and estuarine waters took place owing to upland dissolution of basal limerock from increased rainfall and ground run-off. This period, closed at approximately 2400 B. C. At this 2400 B. C. date, a warming trend started with a gradual rise in temperature and less rainfall. A progressive rise in the ocean's level would have, at the same time, created an increasing influx of saline marine water which would progressively flood the bays and estuaries, carrying away the silt, reducing the excessively concentrated phosphatic mineral contents of the water until a period of optimum concentration of these minerals, for mollusk valve growth and number was reached. These changes occurred at approximately the 96-inch depth, or about 2000 B. C. A continued rise in the ocean's level would have gradually reduced the mineral content of the bays and estuaries until the optimum concentration of phosphates was reduced by the gradual influx of pure marine water. This in turn would create a gradual reduction both in size and in number of mollusks present. The subsequent transition from mud or silt bottom to sand would also develop a situation environmentally unsuited to at least one mollusk, the bivalve <u>Arca transversum</u>, but would bring about an environmental situation fulfilling the requirements of two other Arks, <u>Arca pexata</u>

and Arca secticostata. Both of these shellfish are more indicative of a sand bottom. Between 96 inches and 48 inches the climate again reversed (at approximately 1800 B. C.), with the onset of the next cool, rainy phase. The optimum growth period in this cooler phase did not produce as profound a change in the size average or number of valves present. This, however, is reasonable, considering the rapid erosion of the bottom sediments that would have resulted from the rising ocean level and the increased tidal flow along with the reduced influx of earth sediments and minerals resulting from the lowered annual rainfall during the previous warm phase. This cool period ended at approximately 1250 B. C., or at the 2.5 foot depth (30 inches on the Figures), and was followed again by a warming trend with the optimum being reached at approximately 1000 B. C., or at the surface of the midden (Figure 4).

The Palmer Site, or Midden, at the point associated with Test I and Test II, had a surface date of approximately 1000 B. C. and a bottom date of 2140 B. C. Within this time spread three ecological-environmental periods of change were noted. These were two warm, dry periods, each containing a period of optimum growth for mollusks at their mid-point, and a cool, wet period in between. The duration of these periods was approximately six hundred years. Since the midden was abandoned before the termination of the last warm, dry period, it can only be assumed that it would also have lasted six hundred years, its optimum growth period occurring at 1000 B. C., or three hundred years from that specific cycles beginning, as is illustrated in Figure 7.

Owing to the lack of obvious erosion at the Palmer Site, which would have resulted if the ocean's level was 10 feet above the present level at 1800 B. C., the author's conclusions were based on a modification of the ideas suggested by both Neill and Clench.

It is also the author's conclusion that the Palmer Site and the Cotten Site exibit similarities that tend to give more validity to the ecological interpretations of the Cotton Site by Griffin and Smith.

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APPENDIX

FIGURE 8

THE INITIAL TEST PIT, PALMER SITE,
OSPREY, SARASOTA COUNTY, FLORIDA

FIGURE 9

TEST I, PALMER SITE, SHOWING VERTICAL SAMPLE TRENCH

FIGURE 10

THE CONCENTRATION OF SHELLS IN SITE
AT THE 96 INCH LEVEL

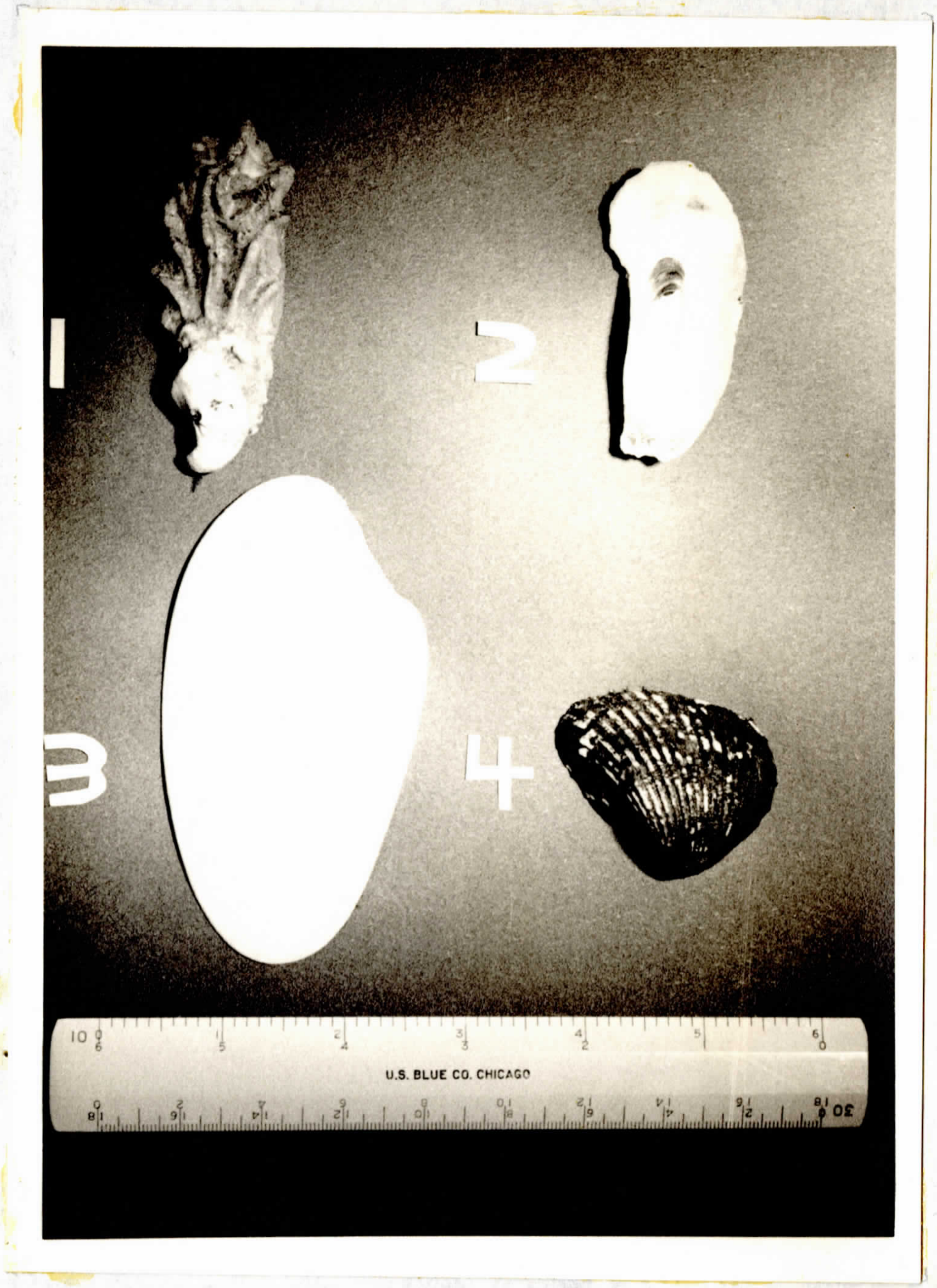

FIGURE 11

1. VIRGINIA OYSTER (Crassostrea virginica Gmelin)
2. VIRGINIA OYSTER, VALVE INTERIOR
3. SUN RAY CLAM (Macrocallista nimbosa Solander)
4. BLOODY CLAM (Arca pexata Say)

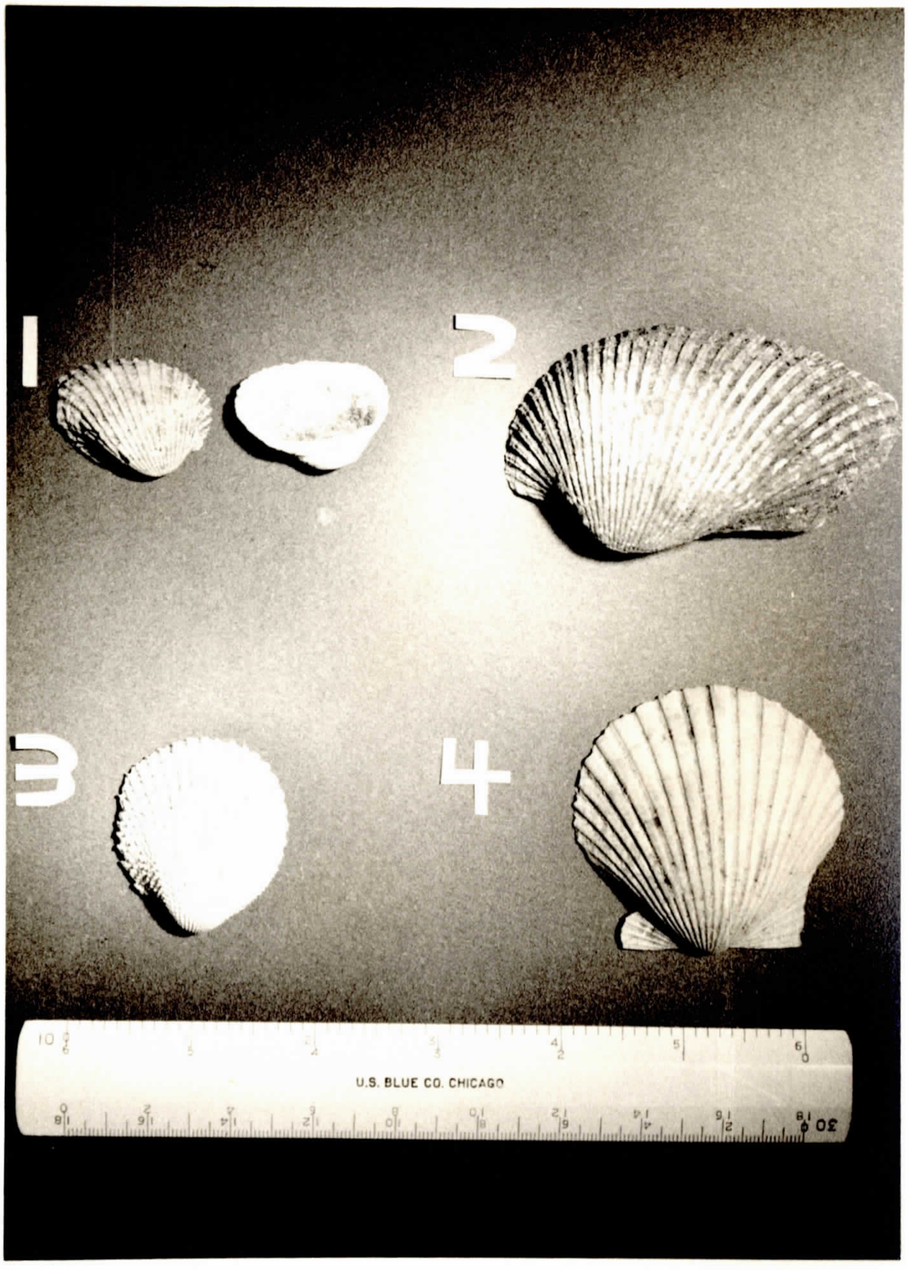

FIGURE 12

1. TRANSVERSE ARK (_Arca transversum_ Say)
2. CUT RIBBED ARK (_Arca secticostata_ Reeve)
3. COMMON COCKLE (_Trachycardium muricatum_ Linne)
4. BAY SCALLOP (_Pectin irradians_ Lamarck)

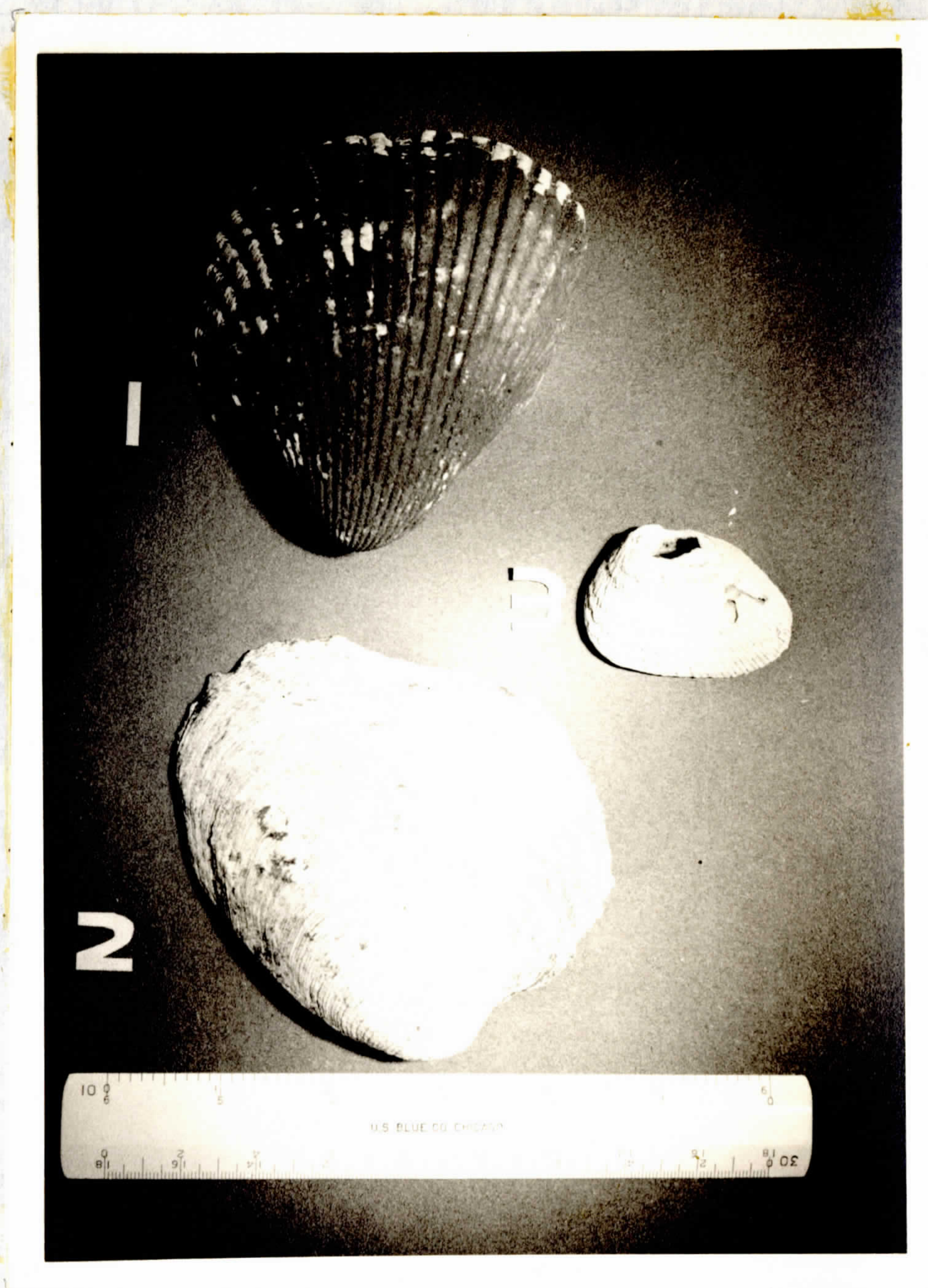

FIGURE 13

1. GREAT HEART COCKLE (<u>Dinocardium robustum</u> Solander)
2. SOUTHERN BAY CLAM (<u>Venus campechiensis</u> Gmelin)
3. TYPICAL TOOL OR ORNAMENT MADE FROM THE BLOODY CLAM, SHOWING PERFORATED BEAK.

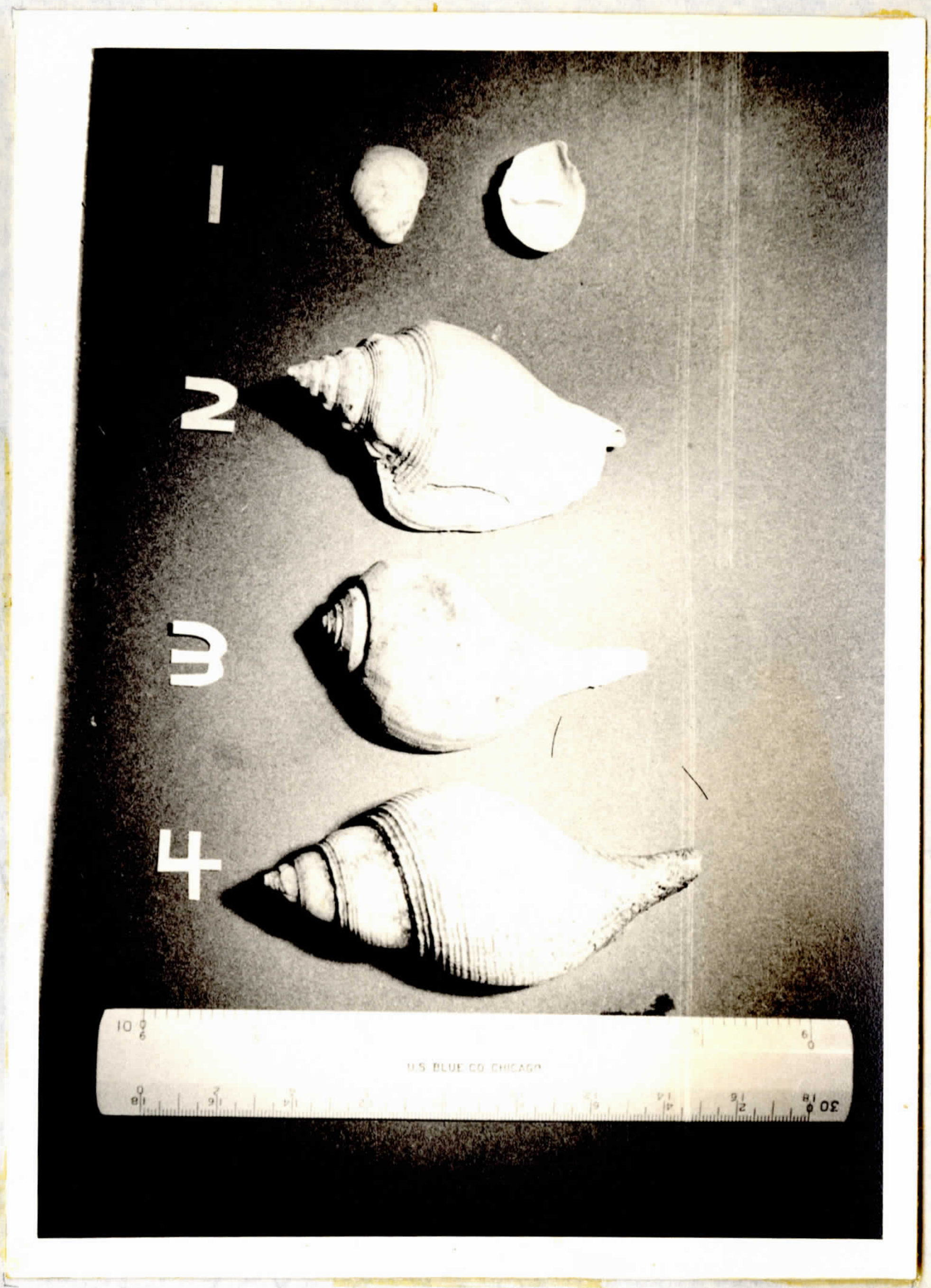

FIGURE 14

1. BOAT SHELL (*Crepidula formicata* Linne)
2. FLORIDA CONCH (*Strombus alatus* Gmelin)
3. FIG SHELL (*Busycon pyrum* Dillwyn)
4. TULIP SHELL (*Fasciolaria tulipa* Linne)

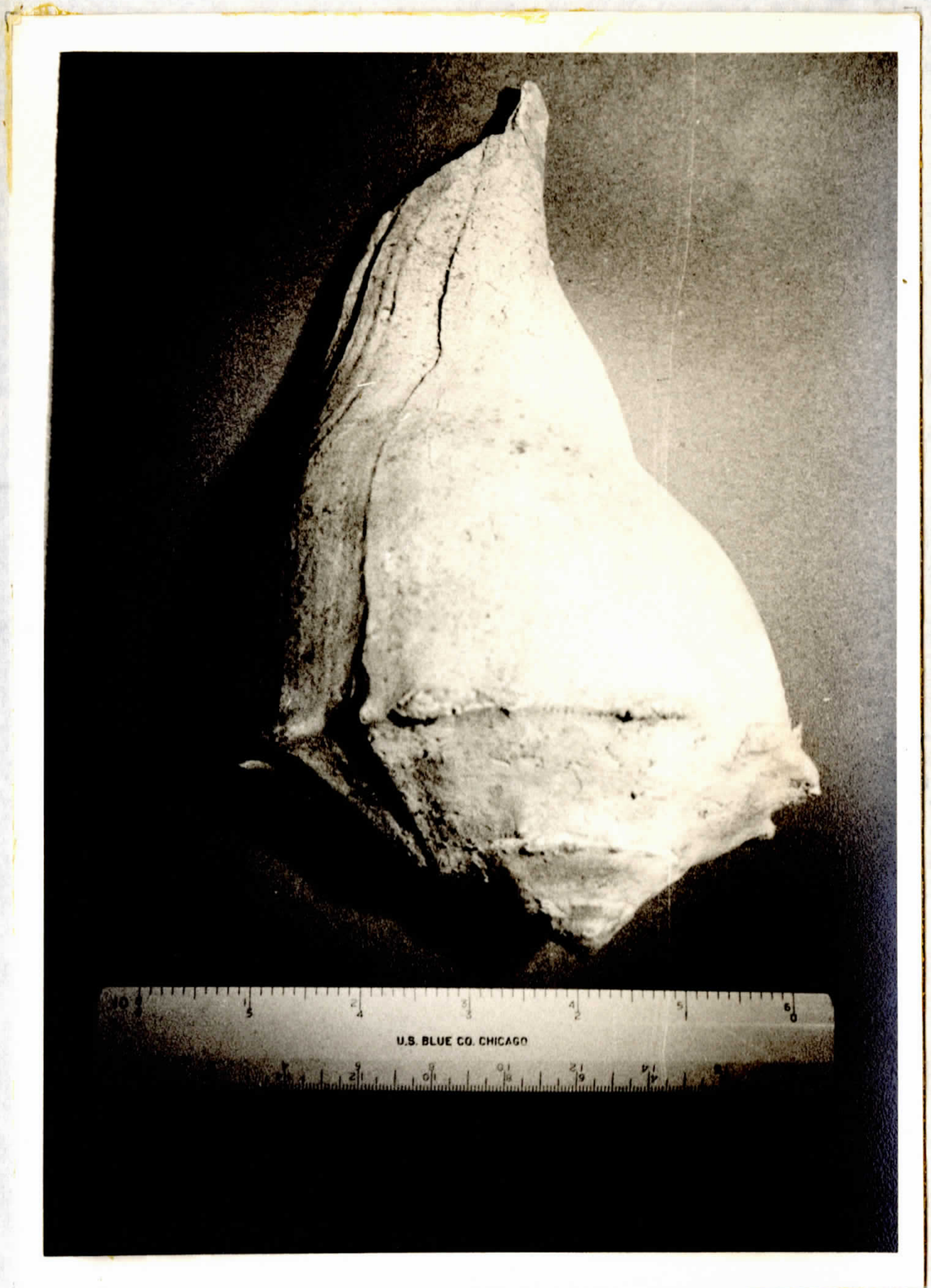

FIGURE 15

LIGHTNING CONCH (<u>Busycon</u> <u>perversum</u> Linne)

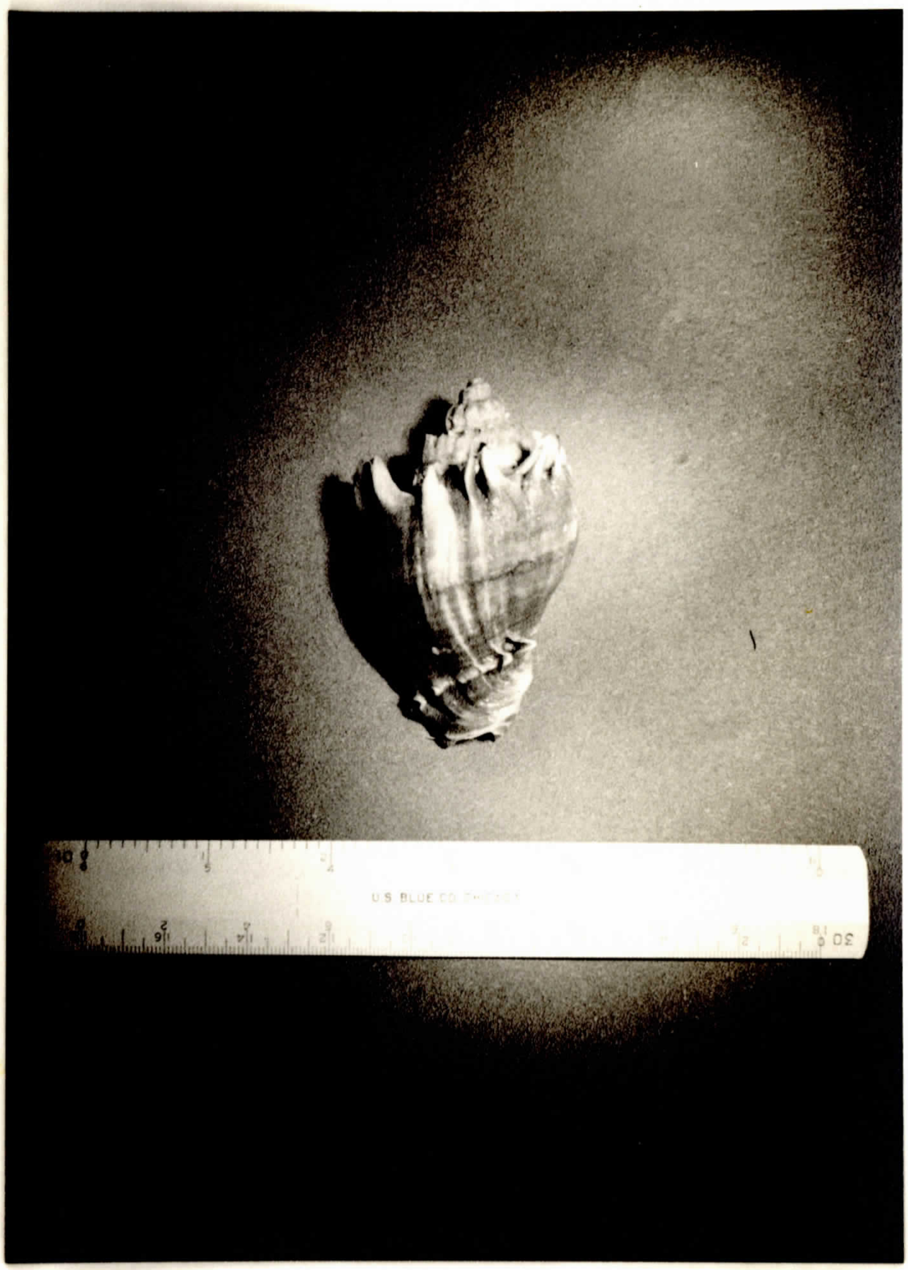

FIGURE 16

CROWN CONCH (Melongena corona Gmelin)

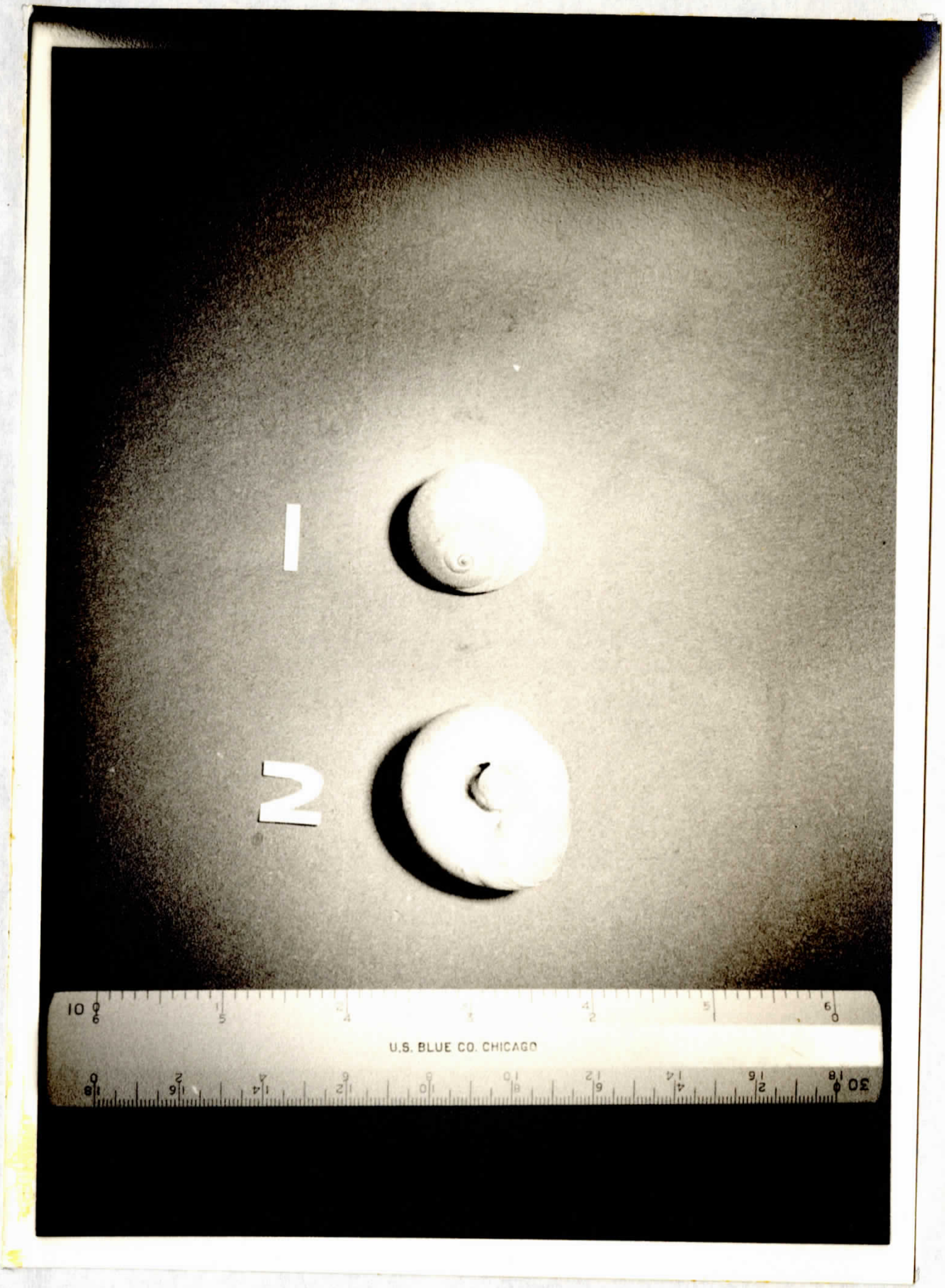

FIGURE 17

LOBED MOON SHELL (<u>Polinices duplicata</u> Say)
(Two aspects)

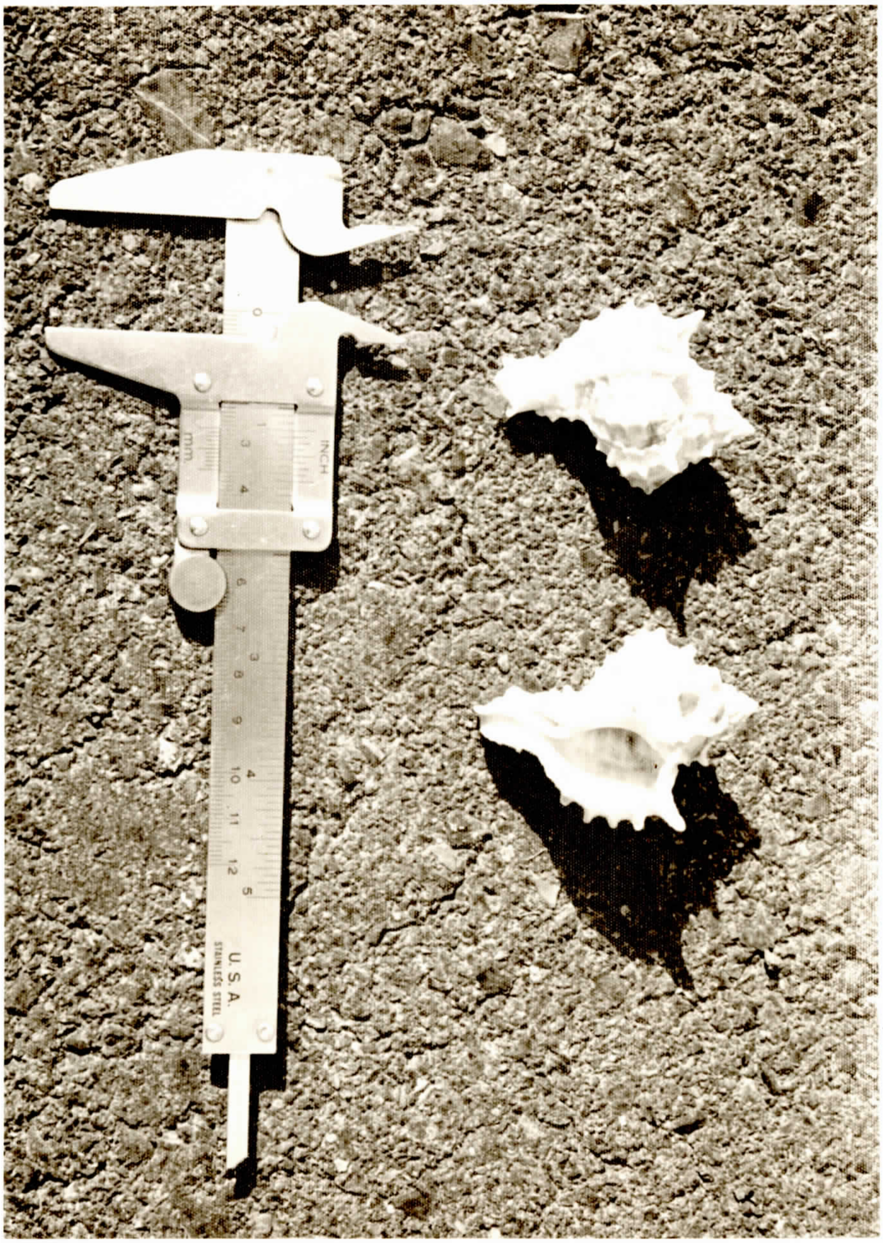

FIGURE 18

APPLE MUREX (Murex pomum Gmelin)

FIGURE 19

HORSE CONCH (Fasciolaria gigantea Riener)